E 1.17: 14/1
Index Table
Technology and Science
Detroit Public Library

Vol. 14, No. 1
January 15, 1989

Energy Research Abstracts

Abstracts 1-2740

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

International Copyright, © U.S. Department of Energy, 1989, under the provisions of the Universal Copyright Convention.
United States copyright is not asserted under the United States Copyright Law, Title 17, United States Code.

Vol. 14, No. 1
ISSN: 0160-3604
CODEN: ERABD
January 15, 1989

D-51

ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through the Energy Data Information System (EDIS) maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* from the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401, FTS 626-8401.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for 24 semimonthly issues is $184.00 for domestic subscribers and $230.00 for foreign subscribers. A single issue costs $27.00, domestic, or $33.75, foreign. Cumulative indexes are available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Managing Editor, Audrey B. Smith
Technical Editor, M. Catherine Grissom

Detroit Public Library

JAN 26 1989

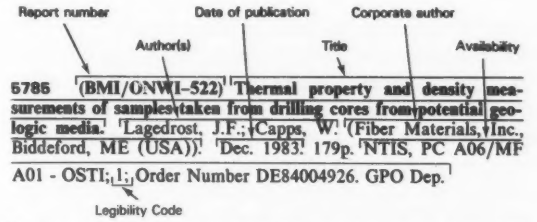
Depository Document

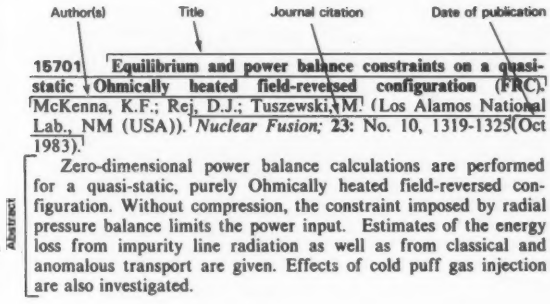
Office of Scientific and Technical Information
United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831

HOW TO USE *ENERGY RESEARCH ABSTRACTS*

ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01 - OSTI; Order Number DE84004926. GPO Dep.
Legibility Code
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	**9:5785**	**NTIS, PC A09/MF A01. OSTI Order Number DE84004926, Distribution Category MN-70**

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6.

01 COAL AND COAL PRODUCTS
- 03 Preparation
- 04 Processing
- 05 By-Products
- 06 Properties
- 08 Waste Management
- 09 Environmental Aspects
- 10 Reserves and Exploration
- 20 Mining
- 30 Transport and Handling
- 40 Combustion
- 50 Marketing and Economics
- 60 Health and Safety
- 70 Legislation and Regulations

02 PETROLEUM
- 01 Reserves
- 02 Geology and Exploration
- 03 Drilling and Production
- 04 Processing
- 05 Products and By-Products
- 06 Health and Safety
- 07 Marketing and Economics
- 08 Waste Management
- 09 Environmental Aspects
- 10 Legislation and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Storage
- 50 Combustion

03 NATURAL GAS
- 01 Reserves
- 02 Geology and Exploration
- 03 Drilling, Production, and Processing
- 04 Products and By-Products
- 05 Health and Safety
- 06 Marketing and Economics
- 07 Waste Management
- 08 Environmental Aspects
- 09 Artificial Stimulation
- 10 Legislation and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Combustion
- 50 Storage

04 OIL SHALES AND TAR SANDS
- 01 Reserves and Exploration
- 02 Site Geology and Hydrology
- 03 Drilling, Fracturing, and Mining
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 06 Direct Uses and By-Products
- 07 Health and Safety
- 08 Marketing and Economics
- 09 Waste Research and Management
- 10 Environmental Aspects
- 20 Regulations

05 NUCLEAR FUELS
- 01 Reserves, Exploration, and Mining
- 04 Feed Processing
- 05 Uranium Enrichment
- 07 Fuels Production and Properties
- 08 Spent Fuels Reprocessing
- 09 Transport and Storage
- 10 Marketing, Economics, and By-Products
- 20 Waste Management
- 30 Environmental Aspects
- 40 Health and Safety
- 50 Safeguards, Inspection, and Accountability
- 60 Legislation and Regulations

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY
- 01 Physical Isotope Separation
- 02 Radiation Sources
- 03 Isotopic Power Supplies
- 04 Economics

08 HYDROGEN
- 01 Production
- 02 Storage
- 03 Transport
- 04 Marketing and Economics
- 05 Safety
- 06 Industrial and Commercial Use
- 07 By-Products
- 08 Properties
- 09 Environmental Aspects

09 OTHER SYNTHETIC AND NATURAL FUELS
- 01 Hydrocarbon Fuels
- 02 Alcohol Fuels
- 03 Inorganic Hydrogen Compound Fuels
- 04 Solid Waste and Wood Fuels
- 05 Liquid Waste Fuels
- 06 Gaseous Waste Fuels

13 HYDRO ENERGY
- 01 Resources and Availability
- 02 Site Geology and Meteorology
- 03 Plant Design and Operation
- 04 Regulations and Licensing
- 05 Economics and Management
- 06 Environmental Aspects
- 07 Power-Conversion Systems

14 SOLAR ENERGY
- 01 Resources and Availability
- 03 Economics
- 04 Environmental, Legal, and Institutional Aspects
- 05 Solar Energy Conversion
- 06 Photovoltaic Power Systems
- 07 Solar Thermal Power Systems
- 08 Ocean Energy Systems
- 09 Solar Thermal Utilization
- 10 Solar Collectors and Concentrators
- 20 Heat Storage

15 GEOTHERMAL ENERGY
- 01 Resource Status and Assessment
- 02 Geology and Hydrology of Geothermal Systems
- 03 Geothermal Exploration and Exploration Technology
- 04 Legal and Institutional Aspects
- 05 Economic and Financial Aspects
- 06 Environmental Aspects and Waste Disposal
- 07 By-Products
- 08 Geothermal Power Plants
- 09 Geothermal Engineering
- 10 Direct Energy Utilization
- 20 Geothermal Data and Theory

16 TIDAL AND WAVE POWER
- 03 Regulations
- 04 Economics
- 05 Environmental Aspects
- 07 Tidal Power Plants
- 08 Wave Energy Converters

17 WIND ENERGY
- 01 Availability (Climatology)
- 03 Regulations
- 04 Economics
- 05 Environmental Aspects
- 06 Wind Energy Engineering

20 ELECTRIC POWER ENGINEERING
- 01 Power Plants and Power Generation
- 02 Environmental Control Technology
- 03 Power Transmission and Distribution

21 NUCLEAR POWER PLANTS
- 01 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled
- 02 Power Reactors, Nonbreeding, Light-Water Moderated, Non-boiling Water Cooled
- 03 Power Reactors, Nonbreeding, Graphite Moderated
- 04 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated
- 05 Power Reactors, Breeding
- 06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
- 07 Regulation and Licensing
- 08 Economics

22 NUCLEAR REACTOR TECHNOLOGY
- 01 Theory and Calculation
- 02 Components and Accessories
- 03 Fuel Elements
- 04 Control Systems
- 05 Environmental Aspects
- 06 Research, Test, and Experimental Reactors
- 07 Plutonium and Isotope Production Reactors
- 08 Propulsion Reactors
- 09 Reactor Safety

25 ENERGY STORAGE
- 01 Magnetic
- 02 Compressed Gas
- 03 Pumped Hydro
- 04 Capacitor Banks
- 05 Flywheels
- 06 Thermal
- 07 Liquefied Gas
- 08 Chemical
- 09 Batteries

29 ENERGY PLANNING AND POLICY
- 01 Energy Analysis and Modeling
- 02 Economics and Sociology
- 03 Environment, Health, and Safety
- 04 Natural Resources
- 05 Research, Development, Demonstration, and Commercialization
- 06 Nuclear Energy
- 07 Transport and Storage
- 08 Waste Heat Utilization
- 10 Conservation
- 20 Supply, Demand, and Forecasting
- 30 Policy, Legislation, and Regulation
- 40 Fossil Fuels
- 50 Hydrogen and Synthetic Fuels
- 60 Electric Power
- 80 Consumption and Utilization
- 90 Unconventional Sources and Power Generation

30 DIRECT ENERGY CONVERSION
- 01 MHD Generators
- 02 EHD Generators
- 03 Thermoelectric Generators
- 04 Thermionic Converters
- 05 Fuel Cells
- 08 Miscellaneous Converters

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
- 01 Buildings
- 02 Transportation
- 03 Industry and Agriculture
- 06 Municipalities and Community Systems
- 09 Education and Public Relations

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS
- 01 Internal Combustion Engines
- 02 External Combustion Engines
- 03 Electric-Powered Systems
- 04 Hybrid Systems
- 05 Flywheel Propulsion
- 06 Vehicle Design Factors
- 07 Emission Control
- 08 Alternative Fuels

35 ARMS CONTROL
- 01 Policy, Negotiations, and Legislation
- 02 Proliferation
- 03 Verification

36 MATERIALS
- 01 Metals and Alloys
- 02 Ceramics, Cermets, and Refractories
- 06 Other Materials

40 CHEMISTRY
- 01 Analytical and Separations Chemistry
- 02 Inorganic, Organic, and Physical Chemistry
- 04 Electrochemistry
- 05 Photochemistry
- 06 Radiation Chemistry
- 07 Radiochemistry and Nuclear Chemistry
- 08 Combustion, Pyrolysis, and High-Temperature Chemistry

42 ENGINEERING
- 02 Facilities and Equipment
- 03 Lasers
- 04 Heat Transfer and Fluid Flow
- 05 Materials Testing
- 08 Electronic Circuits and Devices
- 09 Waste Processing Plants and Equipment
- 10 Combustion Systems
- 20 Underground Engineering
- 30 Marine Engineering
- 40 Pollution Control Equipment
- 50 Power Cycles

43 PARTICLE ACCELERATORS
- 01 Design, Development, and Operation
- 02 Beam Dynamics, Field Calculations, and Ion Optics
- 03 Auxiliaries and Components
- 04 Storage Rings

44 INSTRUMENTATION
- 01 Radiation Instrumentation
- 02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
- 03 Miscellaneous Instruments
- 04 Well Logging Instrumentation

45 EXPLOSIONS AND EXPLOSIVES
- 01 Chemical
- 02 Nuclear
- 03 Explosion Detection

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

52 ENVIRONMENTAL SCIENCES, AQUATIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

53 ENVIRONMENTAL—SOCIAL ASPECTS OF ENERGY TECHNOLOGIES
- 01 Social and Economic Studies
- 02 Assessment of Energy Technologies

55 BIOMEDICAL SCIENCES, BASIC STUDIES
- 01 Behavioral Biology
- 02 Biochemistry
- 03 Cytology

55 BIOMEDICAL SCIENCES, BASIC STUDIES (CONT.)
04 Genetics
05 Metabolism
06 Medicine
07 Microbiology
08 Morphology
09 Pathology
10 Physiological Systems
20 Public Health
30 Agriculture and Food Technology

56 BIOMEDICAL SCIENCES, APPLIED STUDIES
01 Radiation Effects
02 Thermal Effects
03 Chemicals Metabolism and Toxicology
04 Other Environmental Pollutant Effects

57 HEALTH AND SAFETY

58 GEOSCIENCES
01 Geology and Hydrology
02 Geophysics
03 Mineralogy, Petrology, and Rock Mechanics
04 Geochemistry
05 Oceanography

64 PHYSICS I
01 Astrophysics and Cosmology
02 Atmospheric Physics
03 Atomic, Molecular, and Chemical Physics
04 Fluid Physics
50 High Energy Physics

65 PHYSICS II
10 Nuclear Physics
12-20 Nuclear Properties and Reactions
30 Nuclear Theory
40 Radiation and Shielding Physics
50 Medical Physics
60 Condensed Matter Physics
61 Superconductivity
70 Theoretical and Mathematical Physics

70 FUSION ENERGY
01 Plasma Research
02 Fusion Power Plant Technology

99 GENERAL AND MISCELLANEOUS
01 Management
02 Mathematics and Computers
03 Information Handling
04 Law
05 Civilian Defense

CORPORATE AUTHOR INDEX

PERSONAL AUTHOR INDEX

SUBJECT INDEX

CONTRACT NUMBER INDEX

REPORT NUMBER INDEX

ORDER NUMBER CORRELATION

SUBJECT CONTENTS (ALPHABETICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS
- 08 Alternative Fuels
- 03 Electric-Powered Systems
- 07 Emission Control
- 02 External Combustion Engines
- 05 Flywheel Propulsion
- 04 Hybrid Systems
- 01 Internal Combustion Engines
- 06 Vehicle Design Factors

35 ARMS CONTROL
- 01 Policy, Negotiations, and Legislation
- 02 Proliferation
- 03 Verification

56 BIOMEDICAL SCIENCES, APPLIED STUDIES
- 03 Chemicals Metabolism and Toxicology
- 04 Other Environmental Pollutant Effects
- 01 Radiation Effects
- 02 Thermal Effects

55 BIOMEDICAL SCIENCES, BASIC STUDIES
- 30 Agriculture and Food Technology
- 01 Behavioral Biology
- 02 Biochemistry
- 03 Cytology
- 04 Genetics
- 06 Medicine
- 05 Metabolism
- 07 Microbiology
- 08 Morphology
- 09 Pathology
- 10 Physiological Systems
- 20 Public Health

40 CHEMISTRY
- 01 Analytical and Separations Chemistry
- 08 Combustion, Pyrolysis, and High-Temperature Chemistry
- 04 Electrochemistry
- 02 Inorganic, Organic, and Physical Chemistry
- 05 Photochemistry
- 06 Radiation Chemistry
- 07 Radiochemistry and Nuclear Chemistry

01 COAL AND COAL PRODUCTS
- 05 By-Products
- 40 Combustion
- 09 Environmental Aspects
- 60 Health and Safety
- 70 Legislation and Regulations
- 50 Marketing and Economics
- 20 Mining
- 03 Preparation
- 04 Processing
- 06 Properties
- 10 Reserves and Exploration
- 30 Transport and Handling
- 08 Waste Management

30 DIRECT ENERGY CONVERSION
- 02 EHD Generators
- 05 Fuel Cells
- 01 MHD Generators
- 08 Miscellaneous Converters
- 04 Thermionic Converters
- 03 Thermoelectric Generators

20 ELECTRIC POWER ENGINEERING
- 02 Environmental Control Technology
- 01 Power Plants and Power Generation
- 03 Power Transmission and Distribution

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
- 01 Buildings
- 09 Education and Public Relations
- 03 Industry and Agriculture
- 06 Municipalities and Community Systems
- 02 Transportation

29 ENERGY PLANNING AND POLICY
- 10 Conservation
- 80 Consumption and Utilization
- 02 Economics and Sociology
- 60 Electric Power
- 01 Energy Analysis and Modeling
- 03 Environment, Health, and Safety
- 40 Fossil Fuels
- 50 Hydrogen and Synthetic Fuels
- 04 Natural Resources
- 06 Nuclear Energy
- 30 Policy, Legislation, and Regulation
- 05 Research, Development, Demonstration, and Commercialization
- 20 Supply, Demand, and Forecasting
- 07 Transport and Storage
- 90 Unconventional Sources and Power Generation
- 08 Waste Heat Utilization

25 ENERGY STORAGE
- 09 Batteries
- 04 Capacitor Banks
- 08 Chemical
- 02 Compressed Gas
- 05 Flywheels
- 07 Liquefied Gas
- 01 Magnetic
- 03 Pumped Hydro
- 06 Thermal

42 ENGINEERING
- 10 Combustion Systems
- 08 Electronic Circuits and Devices
- 02 Facilities and Equipment
- 04 Heat Transfer and Fluid Flow
- 03 Lasers
- 30 Marine Engineering
- 05 Materials Testing
- 40 Pollution Control Equipment
- 50 Power Cycles
- 20 Underground Engineering
- 09 Waste Processing Plants and Equipment

52 ENVIRONMENTAL SCIENCES, AQUATIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

53 ENVIRONMENTAL—SOCIAL ASPECTS OF ENERGY TECHNOLOGIES
- 02 Assessment of Energy Technologies
- 01 Social and Economic Studies

45 EXPLOSIONS AND EXPLOSIVES
- 01 Chemical
- 03 Explosion Detection
- 02 Nuclear

70 FUSION ENERGY
- 02 Fusion Power Plant Technology
- 01 Plasma Research

99 GENERAL AND MISCELLANEOUS
- 05 Civilian Defense
- 03 Information Handling
- 04 Law
- 01 Management
- 02 Mathematics and Computers

58 GEOSCIENCES
- 04 Geochemistry
- 01 Geology and Hydrology
- 02 Geophysics
- 03 Mineralogy, Petrology, and Rock Mechanics
- 05 Oceanography

15 GEOTHERMAL ENERGY
- 07 By-Products
- 10 Direct Energy Utilization
- 05 Economic and Financial Aspects
- 06 Environmental Aspects and Waste Disposal
- 02 Geology and Hydrology of Geothermal Systems
- 20 Geothermal Data and Theory
- 09 Geothermal Engineering
- 03 Geothermal Exploration and Exploration Technology
- 08 Geothermal Power Plants
- 04 Legal and Institutional Aspects
- 01 Resource Status and Assessment

57 HEALTH AND SAFETY

13 HYDRO ENERGY
- 05 Economics and Management
- 06 Environmental Aspects
- 03 Plant Design and Operation
- 07 Power-Conversion Systems
- 04 Regulations and Licensing
- 01 Resources and Availability
- 02 Site Geology and Meteorology

08 HYDROGEN
- 07 By-Products
- 09 Environmental Aspects
- 06 Industrial and Commercial Use
- 04 Marketing and Economics
- 01 Production
- 08 Properties
- 05 Safety
- 02 Storage
- 03 Transport

44 INSTRUMENTATION
- 03 Miscellaneous Instruments
- 02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
- 01 Radiation Instrumentation
- 04 Well Logging Instrumentation

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY
- 04 Economics
- 03 Isotopic Power Supplies
- 01 Physical Isotope Separation
- 02 Radiation Sources

36 MATERIALS
- 02 Ceramics, Cermets, and Refractories
- 01 Metals and Alloys
- 06 Other Materials

03 NATURAL GAS
- 09 Artificial Stimulation
- 40 Combustion
- 03 Drilling, Production, and Processing
- 08 Environmental Aspects
- 02 Geology and Exploration
- 05 Health and Safety
- 10 Legislation and Regulation
- 06 Marketing and Economics
- 04 Products and By-Products
- 30 Properties
- 01 Reserves
- 50 Storage
- 20 Transport, Pipelines, and Handling
- 07 Waste Management

05 NUCLEAR FUELS
- 30 Environmental Aspects
- 04 Feed Processing
- 07 Fuels Production and Properties
- 40 Health and Safety
- 60 Legislation and Regulations
- 10 Marketing, Economics, and By-Products
- 01 Reserves, Exploration, and Mining
- 50 Safeguards, Inspection, and Accountability
- 08 Spent Fuels Reprocessing
- 09 Transport and Storage
- 05 Uranium Enrichment
- 20 Waste Management

21 NUCLEAR POWER PLANTS
- 08 Economics
- 06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
- 05 Power Reactors, Breeding
- 03 Power Reactors, Nonbreeding, Graphite Moderated
- 01 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled
- 02 Power Reactors, Nonbreeding, Light-Water Moderated, Non-boiling Water Cooled
- 04 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated
- 07 Regulation and Licensing

22 NUCLEAR REACTOR TECHNOLOGY
- 02 Components and Accessories
- 04 Control Systems
- 05 Environmental Aspects
- 03 Fuel Elements
- 07 Plutonium and Isotope Production Reactors
- 08 Propulsion Reactors
- 09 Reactor Safety
- 06 Research, Test, and Experimental Reactors
- 01 Theory and Calculation

04 OIL SHALES AND TAR SANDS
- 06 Direct Uses and By-Products
- 03 Drilling, Fracturing, and Mining
- 10 Environmental Aspects
- 07 Health and Safety
- 08 Marketing and Economics
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 20 Regulations
- 01 Reserves and Exploration
- 02 Site Geology and Hydrology
- 09 Waste Research and Management

09 OTHER SYNTHETIC AND NATURAL FUELS
- 02 Alcohol Fuels
- 06 Gaseous Waste Fuels
- 01 Hydrocarbon Fuels
- 03 Inorganic Hydrogen Compound Fuels
- 05 Liquid Waste Fuels
- 04 Solid Waste and Wood Fuels

43 PARTICLE ACCELERATORS
- 03 Auxiliaries and Components
- 02 Beam Dynamics, Field Calculations, and Ion Optics
- 01 Design, Development, and Operation
- 04 Storage Rings

02 PETROLEUM
- 50 Combustion
- 03 Drilling and Production
- 09 Environmental Aspects
- 02 Geology and Exploration
- 06 Health and Safety
- 10 Legislation and Regulation
- 07 Marketing and Economics
- 04 Processing
- 05 Products and By-Products
- 30 Properties
- 01 Reserves
- 40 Storage
- 20 Transport, Pipelines, and Handling
- 08 Waste Management

64 PHYSICS I
- 01 Astrophysics and Cosmology
- 02 Atmospheric Physics
- 03 Atomic, Molecular, and Chemical Physics
- 04 Fluid Physics
- 50 High Energy Physics

65 PHYSICS II
- 60 Condensed Matter Physics
- 50 Medical Physics
- 10 Nuclear Physics
- 12-20 Nuclear Properties and Reactions
- 30 Nuclear Theory
- 40 Radiation and Shielding Physics
- 61 Superconductivity
- 70 Theoretical and Mathematical Physics

14 SOLAR ENERGY
- 03 Economics
- 04 Environmental, Legal, and Institutional Aspects
- 20 Heat Storage
- 08 Ocean Energy Systems
- 06 Photovoltaic Power Systems
- 01 Resources and Availability
- 10 Solar Collectors and Concentrators
- 05 Solar Energy Conversion
- 07 Solar Thermal Power Systems
- 09 Solar Thermal Utilization

16 TIDAL AND WAVE POWER
- 04 Economics
- 05 Environmental Aspects
- 03 Regulations
- 07 Tidal Power Plants
- 08 Wave Energy Converters

17 WIND ENERGY
- 01 Availability (Climatology)
- 04 Economics
- 05 Environmental Aspects
- 03 Regulations
- 06 Wind Energy Engineering

CORPORATE AUTHOR INDEX

PERSONAL AUTHOR INDEX

SUBJECT INDEX

CONTRACT NUMBER INDEX

REPORT NUMBER INDEX

ORDER NUMBER CORRELATION

ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 21

1 **(CONF-880770—) Coal: Targets of opportunity workshop: Proceedings.** (Sheladia Associates, Inc., Rockville, MD (USA)). Sep 1988. Contract AC01-84FE60457. 262p. NTIS, PC A12/MF A01. Order Number DE89002076/JAW.

From Coal - targets of opportunity workshop; Washington, DC, USA (12 Jul 1988).

The objective of the workshop was to explore new concepts and ideas for using coal in innovative ways to meet energy requirements. This workshop builds on an earlier meeting, the New Fuel Forms Workshop held in February 1986, whose purpose was to reorient and re-evaluate the opportunities that exist for increasing coal use in the United States. The workshop brought together participants from diverse perspectives. Topics discussed were: (1) Site-Specific Coal Energy System Assessment, (2) Design and Operation of a Coal-Based Energy System for a Diverse Urban District Heating Network, (3) The Innovatech System to Replace Distillate in Small Industrial, Commercial, and Residential Applications, (4) Coal-Derived Fuels as Successful Petroleum Replacements and Unique Opportunities Offered to US Railroads, (5) Liquid Coal--The Future Fuel for Locomotive Engines, (6) The Conversion of Coal to Liquids and Gases by Advanced Bioprocessing Systems, (7) Coal-Water Fuel Retrofit Evaluations, (8) Advanced Energy Technologies at Combustion Engineering, Inc., (9) Mild Gasification of Coal: Potential Opportunities for Value-Added Uses, (10) Use of Coal-Lime-Water Slurry Fuels in Power Generation, and (11) Fossil Resins from Coal--A Wasted Resource and Target of Opportunity. Individual projects are processed separately for the databases.

0103 Preparation

2 **(CONF-881172—1) The environmental promise of clean coal technology in the United States.** Streets, D.G.; Dials, G.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01. Order Number DE89000530/JAW.

From Coal 88: 7th international conference and exhibition on coal technology and coal trade; Amsterdam, Netherlands (21 Nov 1988).

Countries, such as the United States, that possess large indigenous coal resources and established coal-consuming industries are under renewed pressure to reduce the air pollution problems that accompany the combustion of coal. Increasingly, these problems are of a regional or global nature, such as acid rain, carbon dioxide production, and ozone formation (from nitrogen oxides). These coal- producing nations desire to achieve further environmental protection, but without damage to domestic industries, and while permitting further economic expansion and ensuring a reliable supply of electricity. Clean coal technology offers the promise of being able to accommodate all facets of this issue; fulfilling the promise will require the commitment of government, industry, and environmentalists. 9 refs., 2 figs., 1 tab.

3 **(DOE/PC/88861—T3) High-sulfur coal research at the SIUC [Southern Illinois University at Carbondale] Coal Technology Laboratory: Quarterly progress report, July 1-September 31, 1988.** (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). Oct 1988. Contract FC22-88PC88861. 133p. NTIS, PC A07/MF A01. Order Number DE89001781/JAW.

Research on high-sulfur coal which is taking place in the Coal Technology Laboratory at Southern Illinois University at Carbondale is divided into four general categories: coal science, coal preparation, coal conversion, and coal utilization. The work in these four areas covers a broad spectrum of high-sulfur coal research from the very fundamental aspects of the coal, through its physical beneficiation and possible conversion, to its ultimate utilization. 34 refs., 36 figs., 4 tabs.

4 **(DOE/PETC/TR—88/1) Importance of classifying circuitry on the successful application of reverse coal-pyrite flotation.** Miller, K.J. (USDOE Pittsburgh Energy Technology Center, PA). Feb 1988. 13p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006984/JAW.

A laboratory-scale test program utilizing the DOE reverse coal-pyrite flotation process was conducted at a coal preparation plant in Pennsylvania with samples of high-sulfur secondary flotation circuit feed that was split from the main fine coal stream by classifying cyclones and sieve bends. The test program showed that the circuit arrangement, with the addition of reverse coal-pyrite flotation, consistently produced a low-sulfur clean coal containing less than 1% pyritic sulfur from a high-sulfur fraction that was usually discarded. In contrast, the high-sulfur froth reject product contained as much as 14% pyritic sulfur. An important factor in the successful utilization of the reverse pyrite flotation process lies in concentrating and isolating the refractory high-pyritic-sulfur fraction of the fine coal preparatory to reverse pyrite flotation. 7 refs., 4 figs., 5 tabs.

5 **(DOE/PETC/TR—88/2-Pt.1) Development of a centrifugal float-sink procedure for gravimetric evaluation of ultrafine coals: Part 1, The effects of surface-property-related parameters on fine-coal separations.** Cavallaro, J.A.; Killmeyer, R.P. (USDOE Pittsburgh Energy Technology Center, PA). Feb 1988. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007300/JAW.

This report traces the development of a centrifugal float-sink technique for determining the washability analyses of fine coal having top sizes finer than 14 mesh. All testing was performed on the Upper and Lower Kittanning bed coals only. The efforts of other researchers attempting to utilize the centrifuge for float-sink testing ultrafine coal are reviewed briefly. Exploratory test data from PETC are presented to show the effect of surfactant additions, reverse float-sink testing, and preheating of samples on the yield/ash relationships. The results of a 33-test partial factorial design used to evaluate five variables at five levels and their effects on the yield/ash relationship as depicted by an efficiency index are presented, along with follow-up tests showing the importance of lower solids concentration and higher reagent dosage. Coal moisture content and reagent dosage had the most significant effect on the yield/ash relationship. 12 refs., 9 figs., 16 tabs.

0104 Processing

REFER ALSO TO CITATION(S) 1, 3, 22, 49, 344, 715

6 **(AD-A—195907/1/XAB) Production of jet fuels from coal-derived liquids. Volume 2. Characterization of liquid by-products from the Great Plains Gasification Plant. Interim report, 26 November 1986-1 February 1988.** Knudson, C.L. (North Dakota Univ., Grand Forks (USA). Energy and Minerals Research Center). May 1988. 119p. NTIS, PC A06/MF A01.

The Great Plains Gasification Plant (GPGP) represents the first commercial Syn-Fuels Plant in the United States. The GPGP

produces three by-product hydrocarbon liquid streams (rectisol naphtha, crude phenol and tar oil) which are utilized as plant fuel. The purpose of this work was to characterize these streams in order to more fully understand what would be necessary to produce jet fuel or other more valuable products from these streams. The rectisol naphtha is mostly benzene-toluene-xylene (BTX) material. In the raw form it has a strong odor that can be reduced by sweetening and contains very volatile components including acetone and pentadienes.

7 **(DOE/CH/00016—2588) Flash pyrolysis of coal in reactive and non-reactive gases: Final report, October 1, 1982--September 30, 1986.** Steinberg, M.; Fallon, P.T.; Sundaram, M.S. (Brookhaven National Lab., Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number TI88001095/JAW.

The purpose of this study was to compile a process chemistry data base for the flash pyrolysis of several ranks of coal. The process of flash pyrolysis is defined in terms of reaction conditions as follows: (1) Rapidly heating coal particles to temperatures above approximately 400{degree}C at rates ranging from hundreds to thousands of degrees per second; (2) maintaining a relatively short residence time of the coal particles at reaction temperature and pressure, on the order of less than one second to tens of seconds; and (3) rapidly cooling the reaction system, at rates on the order of hundreds of degrees per second, to temperatures below about 300{degree}C. In this manner, yields of gases and lighter liquids tend to increase and the yields of heavier oils, tars, and chars decrease. A number of methods can be used to obtain the rapid heat up rate of the coal particles. The optimum method, from a process point of view, is by the use of a preheated gas stream which is rapidly mixed with the coal feed material. Thus, this report covers the flash pyrolysis of coal particles mixed and entrained with preheated reactive and non-reactive gases. 16 refs., 15 tabs., 27 figs.

8 (DOE/METC—86/6043, pp 133-143) **Wet carbonization of lump-size low-rank coals.** Roberts, M.J.; Mensinger, M.C.; Srivastava, V.; Rue, D.M. (Institute of Gas Technology, Chicago, IL (USA)). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of this program is to experimentally determine the technical feasibility and evaluate the economics of wet carbonizing lump-size low-rank coals by a non-slurry approach.

9 (DOE/METC—86/6043, pp 216-224) **Low cost hydrogen/novel membrane technology for hydrogen separation from synthesis gas.** Baker, R.; Wijmans, H.; Pinnau, I.; Roberts, D. (Membrane Technology and Research, Inc., Menlo Park, CA (USA)). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The separation of hydrogen from synthesis gas is a major cost element in the manufacture of hydrogen from coal. Separation of these gases by membranes is a alternative technique that is still largely unexplored and that could offer substantial cost savings. The objective of this program is to develop membranes suitable for these separations and demonstrate their applicability with small spiral wound modules on model gas mixtures representative of those found in synthesis gas processes.

10 **(DOE/PC/80908—9) Low severity coal conversion by ionic hydrogenation: Report for the period of July-September 1988.** Cheng, J.C.; Larsen, J.W. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 30 Sep 1988. Contract FG22-85PC80908. 11p. NTIS, PC A03/MF A01. Order Number DE89002009/JAW.

Objectives of research are: (1) to explore the ionic hydrogenation of low rank coals using $H_2O:BF_3$ as the acid and hydrogen gas as the hydride donor in the presence of catalytic quantities of transition metal complexes to activate hydrogen; and (2) to develop the optimum reaction conditions. A variety of ionic hydrogenation systems were screened using two test compounds in the search for effective acid/H_2/catalyst combinations. A new ionic hydrogenation system using $H_2O:BF_3/H_2/(CH_3CN)_2\ PtCl_2$ was found to hydrogenate aromatics/polynuclear aromatics (PNAs) and to cleave C-O bonds. The reaction products were characterized using standard, appropriate techniques such as NMR, gas chromatography, mass spectrometry, and elemental analyses. The $H_2O:BF_3/H_2/(MeCN)_2PtCl_2$ system was applied to Wyodak coal in an attempt to develop efficient, near-room-temperature coal conversion chemistry. 9 refs., 1 tab.

11 **(EMR—AC85-185) A study on the desulfurization of coal by bacterial leaching.** O'Neil, D.; Birk, D. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). Apr 1986. 36p. (CE—01960). CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $0.34CAN per page, $3.40 CAN minimum.

A pilot bacterial leaching experiment was conducted on Nova Scotia Prince Mine coal (Hub seam) for two particle sizes. Total sulfur content of the coal was reduced 20% with pyritic sulfur reduced 40% during leaching. Coal innoculated with Thiobacillus ferroxidans did not show a significant difference in the rate of pyrite oxidation compared to coal without innoculation. This is likely due to the presence of indigenous bacteria in the control pile. At least six different hydrated sulfate minerals have precipitated onto the coal. A complex paragenesis is indicated which may relate to the relative influence of chemical versus microbial oxidation activity. The interpretation of data from this leaching experiment is hampered by two factors: non-representative sampling of a coal pile, and lack of sterility in the control pile and thus the influence of indigenous bacteria. 5 refs., 41 figs., 4 tabs.

12 **(NP—9770086) Effects of solvent additions on coal hydrogenation.** Schmidt, H. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 11 Jul 1986. 168p. (In German). . Order Number DE89770086/JAW.

Conditioning oils from coal hydrogenation and coking were investigated with a view to their applicability in catalytic coal hydrogenation. The author started by hydrogenating the oils in a laboratory autoclave at a pressure of 120 bar, temperatures of 435 to 475/sup 0/C, and a time of residue up to 60 min in order to investigate hydrogen uptake and cracking and the changes from the initial H/C ratio. He then investigated the hydrogenation of two different coal grades using either the conditioning oils, red matter, or Co-Mo catalyst. The best results were achieved with the latter. A high initial H:C ratio in the conditioning oil supports asphaltene decomposition, and a higher temperature will result in a higher H/sub 2/ uptake and improve the oil:asphaltene ratio. If the H:C ratio of the oil is high, the conversion peak will be reached after 15 minutes; if it is low, 30 minutes are required.

13 **(PB—88-236898/XAB) Union Carbide Corporation trip report, Chemicals and Plastics Division Institute, West Virginia.** Selevan, S.G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). 13 Apr 1976. 7p. (IWS—59.13). NTIS, PC A02/MF A01.

A walk-through survey was conducted at the Union Carbide Corporation located in Institute, West Virginia, for the purpose of determining the feasibility of including this facility in an epidemiological study of workers involved in coal-hydrogenation operations. The facility started partial operation in 1950 with a large pilot facility operating until 1956 and a smaller pilot facility operating until 1963. A black substance which fluoresced under ultraviolet light contaminated the entire area devoted to coal-hydrogenation. The total number of workers in the facility from 1950 to 1964 was 445. Inspection of worker's skin between 1955 and 1964 revealed skin cancer occurring at 16 to 30 times the expected rate. While the cohort of 445 men could be identified there were some problems. First, the exposures to the coal hydrogenation process were brief. Secondly, all the employees had other exposures, the effects of some of which may be additive, synergistic, or antagonistic, which would obscure the findings of the study. The author concludes that,

primarily due to the diversity of exposures, this facility should not be included in the overall epidemiological survey.

14 **(PB--88-237292/XAB) Trip report, Institute of Gas Technology, HYGAS Pilot Plant, Chicago, Illinois.** (National Inst. for Occupational Safety and Health, Rockville, MD (USA)). 11 Nov 1976. 9p. (IWS—059.11). NTIS, PC A02/MF A01.

A site visit was made to the HYGAS Pilot Facility of the Institute of Gas Technology, Chicago, Illinois, for the purpose of increasing familiarity with the HYGAS process for coal gasification and to inform the operators of the facility concerning the industrial hygiene effort on the part of NIOSH in coal-conversion operations. At this facility 75 tons per day of coal were used to produce 1.5 million cubic feet/day of synthetic pipeline gas. The work force at the facility numbered 85 persons with nine operators per shift, 4.2 shifts per day. A total of 25 cases of occupational injuries and illnesses have been reported at the location including two respiratory disorder cases. One of these was a dust disease of the lungs and the other a respiratory condition due to the presence of toxic agents. One of the workers was involved in vacuuming coal fines in a dusty environment without the use of a respirator. The other employee worked in an area near smoking coal, breathing the fumes, wearing a dust mask. All employees underwent a preemployment physical. Detector tube readings for toluene were negative.

15 **(PNL-SA—16094) Biodegradation of coal-related model compounds.** Campbell, J.A.; Stewart, D.L.; McCulloch, M.; Lucke, R.B.; Bean, R.M. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 9p. (CONF-8809141—1). NTIS, PC A02/MF A01. Order Number DE88015924/JAW.

From National applied superconductivity conference (ASC); Los Angeles, CA, USA (5 Sep 1988).

We have studied the reactions of model compounds having coal-related functionalities (ester linkages, ether linkages, PAH) with the intact organism, cell-free filtrate, and cell-free enzyme of C. versicolor to better understand the process of biosolubilization. Many of the degradation products have been identified by gas chromatography/mass spectroscopy (GC/MS). Results indicate that the two compounds tested with the intact fungal organism were completely degraded. Complete degradation refers to no recovery of model compound. We can probably assume that the other two would also be totally degraded, since we have not yet found a simple compound that will survive long-term exposure to the intact fungus. The ease of degradation with the cell-free filtrate appears to be in the order: phenylbenzoate > benzylbenzoate > benzyl ether > methoxybenzophenone. Esters and ethers that are activated by aromatic rings appear to be susceptible to the fungal extract; however, aromatic ketones are not affected by the extract. From the limited results we have obtained from the isolated enzyme, it appears that the activity may parallel the cell-free filtrate. When the cell-free extract was tested with the model compounds indole, dibenzothiophene, and bibenzyl, no degradation with the enzyme was noted: however, exposure of these compounds to the intact organism resulted in complete degradation. Analysis of the controls indicated no degradation. 8 refs., 1 fig., 1 tab.

0105 By-products

REFER ALSO TO CITATION(S) 6

0106 Properties

REFER ALSO TO CITATION(S) 1, 3, 4, 12, 47, 48, 86, 1071

16 **(ANL/CNSV—66) Viscosity of coal/water slurries at high shear rates.** Sekar, R.R.; Wang, C.S.; Choi, U.S. (Argonne National Lab., IL (USA)). Aug 1988. Contract W-31109-ENG-38. 43p. NTIS, PC A03/MF A01. Order Number DE89001032/JAW.

The service life of an injector nozzle in a diesel engine fueled with of coal/water slurry (CWS) is 2-5 h, which limits the continuous running time of the engine. This study of CWS flow and erosion in injector nozzles was initiated to provide an analytical tool, validated by experiment, for designing a durable injector and predicting long-term wear from limited test runs. The two-phase hydrodynamic theory of solid/liquid slurry flow has been extended to incorporate the constitutive relationship for power-law non-Newtonian behavior. A computer model has been developed to predict the spatial and temporal variations in solid and liquid velocities, viscosities, and concentrations under the high shear rates encountered in diesel injection systems. The model has been validated using Newtonian, single phase flow data obtained with water or No. 2 diesel fuel and non-Newtonian, two-phase flow data using a CWS. The computed and measured viscosities and shear rates showed good agreement. Viscosities of four micronized CWS samples were measured at shear rates between 3000 and 30,000 sec/sup {minus}1/ in a high-pressure/high-shear capillary tube system of a rotational viscometer. The complex CWS flow at high shear depended on coal particle size, temperature, coal loading, additives, and the shear rate. 40 refs., 19 figs., 6 tabs.

17 **(CONF-881123—3) Multiphase hydrodynamic modeling and analysis of non-Newtonian coal/water slurry rheology.** Wang, C.S.; Lyczkowski, R.W.; Berry, G.F. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01. Order Number DE89000584/JAW.

From 3. international symposium on liquid-solid flows (WAM); Chicago, IL, USA (28 Nov 1988).

A multiphase non-Newtonian hydrodynamic model has been developed to predict the spatial and temporal distributions of pressure, relative motion between solids and liquid, solids concentration, and slurry shear rate and viscosity. This model includes separate continuity and momentum equations for each phase and extends the well accepted power-law, non-Newtonian constitutive relationship for shear stress calculations. The model has been partially validated by comparison with single-phase power-law non-Newtonian flow theory and the literature data. The present model has also been used to analyze the pure water, No. 2 diesel fuel and coal/water slurry data measured by using high pressure and high shear rate capillary tube systems. Excellent agreement has been obtained between the calculated and measured values on mixture shear rates and viscosity, mass flow rates, and pressure. 19 refs., 5 figs., 4 tabs.

18 **(CONF-8809161—1) The efficient, large scale separation of coal macerals.** Dyrkacz, G.R.; Bloomquist, C.A.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01. Order Number DE89000619/JAW.

From Symposium on Argonne premium coal samples; Los Angeles, CA, USA (25 Sep 1988).

In our continuing efforts in the area of maceral separation, we have recognized the need for a process to supply relatively large amounts of macerals as rapidly as possible. Earlier we reported some initial work using combined sink/float and density gradient centrifugation (DGC) or continuous flow centrifugation and DGC. There are several notable advantages in using continuous flow centrifugation for maceral separation. First, the coal particles can be in a highly dilute suspension, which reduces particle-particle interactions. Second, large amounts of material can be separated; the major limitation being the capacity of the rotor. Third, the separation efficiency is higher. Unlike batch sink/float centrifuge operations, there are less cross-contamination problems with removal of the light and heavy particles, since the light phase is continuously removed. Lastly, the separation is fast. To produce an equivalent amount of purified coal material, much less manipulation is necessary to achieve separation compared to batch sink/float. With all of these advantages in mind, we have again turned our investigations to continuous flow centrifugation for maceral separations. However, this time we are using a centrifuge specifically designed for such work. We report our initial investigations on the separation of the maceral groups from Lewiston-Stockton coal from the Argonne Premium Coal Sample Program (APCS-7). 5 refs., 4 figs., 1 tab.

19 **(CONF-8809161—2) The determination of the hydroxyl and carboxylic acid content of coal macerals using combined chemical and spectroscopic techniques.** Choi, Cholyoo; Muntean, J.V.; Thompson, A.R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 10p. NTIS, PC A02/MF A01. Order Number DE89000611/JAW.

From Symposium on Argonne premium coal samples; Los Angeles, CA, USA (25 Sep 1988).

Macerals were separated from two high volatile bituminous coals obtained from the Argonne Premium Coal Sample Program and one high volatile bituminous coal from the Pennsylvania State University Coal Sample Bank. A preliminary survey of the nature of these macerals using chemical and spectroscopic techniques are reported. Alkylation using ^{13}C enriched methyl iodide followed by solid ^{13}C NMR analysis were used to determine the concentrations of acidic OH and CH sites in these macerals. The relative quantities of various types of methyl ethers and methyl esters were also estimated from the NMR spectra. 19 refs., 4 figs., 4 tabs.

20 **(CONF-8809161—3) Sample preparation for and current status of the Argonne Premium Coal Sample Program.** Vorres, K.S. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01. Order Number DE89000618/JAW.

From Symposium on Argonne premium coal samples; Los Angeles, CA, USA (25 Sep 1988).

The Argonne Premium Coal Sample Program includes eight coals (Upper Freeport, Wyodak-Anderson, Illinois {number←sign}6, Pittsburgh, Pocahontas {number←sign}3, Utah Blind Canyon, Lewiston-Stockton and Beulah-Zap seams) chosen to provide a range of chemical composition, including sulfur content, maceral content and geographic distribution. One of the purposes is to provide a set of pristine samples for comparison and correlation. They have been collected in ton-sized batches and processed to provide a minimal exposure to oxygen, thoroughly mixed, and packaged in borosilicate glass ampoules containing either 5 grams of -100 mesh or 10 grams of -20 mesh material. This material has been analyzed by a number of laboratories, including a round robin with Commercial Testing and Engineering Co. Further data are being added to an analytical data base as they become available. Over 190 shipments have been made to over 100 different users. Research is currently being carried out in almost every area of coal science with these samples. 8 refs., 1 tab.

21 **(DOE/PC/70781—T11) Stability, rheology and flow of coal-water mixtures: Final report.** Turian, R.M.; Hsu, Feng-Lung. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). Jun 1988. Contract FG22-84PC70781. 69p. NTIS, PC A04/MF A01. Order Number DE88012951/JAW.

This report presents the results of studies on the characterization and rheology of coal-water mixtures (CWM) made up of five different coals. The report covers the period from 9/1/84 to 2/29/88. Results presented include: coal analyses, particle characterization; suspension characterization; measurements of the yield stress of CWM as a function of particle size distribution, solids concentration and suspension pH and their correlation; measurements of the shear stress/shear rate/concentration dependence of CWM for different particle size distributions and their correlation; measurement and correlation of the heat capacities and thermal conductivities of CWM; and studies on sedimentation and sediment property characterization for CWM. The shear stress/shear rate data cover the shear rate range between 10/sup {minus}1/ (l/sec) and 10^5 (l/sec), and were taken mainly using a capillary tube viscometer. A significant characteristic of most of the capillary shear stress/shear rate measurements was the existence of marked wall slip effects, which required correction. Slurry yield stresses were measured directly using the vane geometry and were correlated with concentration using the maximum packing volume fraction as a parameter. The heat capacities of the coal powders and of the coal-water mixtures were found to follow a simple additive group contribution model. The thermal conductivity data on CWM were used to a correlation for effective mixture conductivity based on volume fraction of solids and on ratio of solids to liquid conductivities. In addition, these data were used to develop a procedure for estimating the solid thermal conductivity of the granular coal. 33 refs., 19 figs., 25 tabs.

22 **(DOE/PC/70791—T8) Studies in chemical and electrochemical coal conversion: Final technical report, August 1, 1984--July 31, 1987.** Kubiak, C.P. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). 1987. Contract FG22-84PC70791. 112p. NTIS, PC A06. Order Number DE88010790/JAW.

The overall objective of our work is to contribute new fundamental chemical knowledge of the science and technology of coal conversion. Our initial efforts were dedicated to two sub-areas. (1) The development of new chemistry for the direct utilization of coal gas for the synthesis of specialty organic chemicals, using homogeneous transition metal catalysts. This area involved mechanistic studies of the water gas shift (WGS) and exploratory studies of Reppe hydroformylation and olefin hydration. Many of the original objectives were met and this line of inquiry was extended into new areas of coal chemistry including the catalytic deoxygenation of phenolic residues, studies of carbon-carbon bond formation between C_1 substrates, and studies of heteroatom labilization. (2) The second sub-area of our work is direct electrochemical conversion of coal gas to electricity. This area led to the development of the first, efficient low temperature CO/O_2 fuel cells.

23 **(DOE/PC/80503—T12) Transport and relaxation processes in supercritical fluids: Technical progress report, August 5, 1988-October 20, 1988.** Jonas, J. (Illinois Univ., Urbana (USA). Dept. of Chemistry). 1988. Contract FG22-85PC80503. 5p. NTIS, PC A02/MF A01. Order Number DE89001779/JAW.

During this period our work concentrated on the three following projects. First, we needed to improve the performance of our NMR spectrometer system to achieve better sensitivity. Second, we are finishing the theoretical treatment of the transport and relaxation data for the naphthalene-CO_2 system. Third, the laser Raman scattering experiments on supercritical CO_2-CH_3OH and CO_2+CH_3OH and naphthalene are in progress. 1 fig.

24 **(DOE/PC/90960—9) Rheology of high concentration polymodal multiphase flows: Quarterly report, September 1 1987--August 31, 1988.** Probstein, R.F. (Massachusetts Inst. of Tech., Cambridge (USA)). Oct 1988. Contract FG22-86PC90960. 10p. NTIS, PC A03/MF A01. Order Number DE89001871/JAW.

The objective of this research program is to determine through microhydrodynamic and colloidal dispersion theory and parallel experiments, the rheological characteristics of high-density, stabilized, coal-water slurries. The key parameters to be studied are coal loading, particle shape and size distribution, the chemical and electrochemical characteristics of any absorbed stabilizers, the coal and the carrier fluid properties, and the hydrodynamic state of the system. The basis of the theoretical analysis is to consider a polydisperse pulverized coal slurry as made up of two relatively distinct particle fractions---a coarse fraction and a smaller fine fraction. The particles in the final fraction are of micron size and are assumed to behave colloidally, "stiffening" the liquid and giving the liquid its rheological properties. The coarse fraction, which takes up most of the space, "sees" the stiffened non-Newtonian liquid and raises the viscosity through hydrodynamic dissipation associated with the relative motions of the coarse particles in the "stiffened" liquid. 6 refs., 4 figs.

25 **(NEI-SE—27) Combustion behavior for a range of coals of various origins and petrographic composition.** Bengtsson, M. (Royal Inst. of Tech., Stockholm (Sweden)). May 1986. 172p. NTIS (US Sales Only), PC A08. Order Number DE88755060/JAW.

The following evaluation methods have been used: coal petrography; differential thermogravimetric analysis, DTGA; drop tube furnace, DTF experiments; microscopy on char from DTF; microscopy on char samples from two coals in a 4 MW experimental furnace; microscopy on ashes; and comparison of coal properties - reaction pattern DTGA-DTF and industrial scale burners. Some conclusions: devolatilization starts in vitrinite for HV and MV

coals. Vitrinite rich HV-coals rapidly lose high molecular weight hydrocarbons forming an flammable air-gas mixture with 2-3 percent hydrocarbons and a thin shaled porous char requesting short combustion time. With increasing rank VM releases slowly becomes limited and the proportion of CH/sub 4/increases replacing high molecular weight hydrocarbons, giving a gas mixture requiring a higher proportion of hydrocarbons to air for ignition. In LV-coal devolatiliztion started in inertinite and this component was more reactive in anthracite than vitrinite. For HV and MV coals, the devolatilization from inertinite at 800 degrees Celsius was considerably slower and more limited than in vitrinite, forming compact char requiring long combustion time. In inertinite rich coals, where the small vitrinite fields were surrounded by inertinite, devolatilization of vitrinite was limited at 800 degrees Centigrade but not at 1000 degrees Centigrade where inertinite also devolatilized. The reactivity of these coals were similar to several low inertinite coals of corresponding rank at 1000 degrees Centigrade. Exinite devolatilized rapidly after about 100 ms at 800 degrees Centigrade giving a H-rich gas favoring flame stability. Single grains of fusinite and some other compact high reflecting inertinites burned only from the surface even at high temperature requiring a longer combustion time than coal structures.

26 **(STEV-TORV—88-11) Sulfur in peat VBB.** Karlsson, S. (VBB, Vaexjoe (SE)). (Statens Energiverk, Stockholm (Sweden)). 5 Oct 1987. 24p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755092/JAW.

The sulphur content has been analyzed prior to and three and seven months after draining by ditching of the bog as well as in dried peat. Some drain water samples have been analyzed before and after ditching. No change of the sulphur content in the peat samples has been noted mainly because of the insignificant reduction of the water content in the studied highly humidificated peat (Carex). The sulphur contents vary at random in the water samples. The contents in the samples taken from the newly prepared ditches are somewhat lower compared to the reference sample taken in the natural outlet at the border of the bog. It is therefore assumed that the variation of the sulphur periodically depends of the accumulation and the outleak of sulphur in the form of sulphate. During the drying of the peat samples down to a water content of approx 10 percent, it was noted that the average sulphur content was reduced with 8 percent, from 0.86 to 0.79 g/kg solids. In reality the peat fuel is being dried down to 40-50 percent water content. Consequently, the expected reduction of sulphur will be somewhat lower, approx 5 percent. The provision to obtain a reduction of sulphur in the peat is that either the water content is reduced by draining or that the amount or the quality of the infiltrated streaming water is changed.

0108 Waste Management

REFER ALSO TO CITATION(S) 84, 151, 528, 529, 531, 827, 1710, 1753

27 **(CONF-881120—2) A preliminary evaluation of advanced flue gas clean-up processes using SALT [System Analysis Language Translator] code.** Chang, S.L.; Berry, G.F.; Hu, N. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010052/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

To further reduce the pollutant emissions and to alleviate the acid rain problem, many advanced flue gas clean-up (FGC) processes capable of removing over 90% of both pollutants SO/sub x/ and NO/sub x/ have been developed. To enhance their potential applications, a common base for the evaluation of their performances and costs is required. Such a common base can be provided by a computer simulation which is usually simple, fast and effective. New FGC computer models of fluidized-bed copper oxidation, fluidized-bed sodium absorption, electron beam/spray dryer and electron beam/ammonia injection processes and a simulation program of a typical coal-fired power plant have been developed using System Analysis Language Translator computer code. The clean-up performance and cost are computed from the coal-fired power plant simulation program in which an FGC model is integrated. Preliminary results computed from these FGC models will be discussed and compared. 14 refs., 6 figs.

28 (DOE/PC/70771—T9, pp 2.1-2.29) **Homogeneous kinetic modeling for advanced NOx control processes.** [1988]. NTIS, PC A 05. Order Number DE88012962/JAW.

In Kinetics of nitrogen and sulfur reactions in combustion systems: Quarterly report No. 11.

A homogeneous gas-phase kinetic mechanism was originally developed for the study of NOx reduction during gas reburning. For the present study it has been updated to accommodate sulfur species and to predict NOx reduction through the use of chemical reducing agents in advanced NOx control processes. The mechanism is used with EER's One-Dimensional-Flame code (ODF). ODF is a one-dimensional (non-diffusional) model capable of solving a variety of problems in gas-phase (homogeneous) and gas-solid (heterogeneous) chemical kinetics. It is capable of simulating relevant aspects of premixed and diffusion flames for NOx formation/destruction and hydrocarbon oxidation, and flue-gas chemistry in plug-flow format. It also accommodates sidestream addition. The latter has been applied to modeling gas reburning and burnout, addition of NOx-control additives (e.g. thermal de-NOx studies), and most recently, sidechamber design studies. The non-diffusional aspect of the model means that a homogeneous (perfectly mixed) gas phase is assumed. As a result, the model is capable of predicting limits of performance in the absence of mixing limitations.

29 (DOE/PC/70771—T9, pp 3.1-3.23) **Fundamental research in advanced NOx control processes.** [1988]. NTIS, PC A 05. Order Number DE88012962/JAW.

In Kinetics of nitrogen and sulfur reactions in combustion systems: Quarterly report No. 11.

Recently published work suggests that HNCO may be capable of reducing NO via a selective noncatalytic reaction similar to the reaction of NH_3 in the Thermal DeNOx process but occurring over a wider temperature range. Unpublished experiments by Chen and Pershing have shown that cyanuric acid (a precursor of HNCO) can be used to reduce NO noncatalytically as can urea and $(NH_4)_2SO_4$. Contrary to the results of Perry and Sieber, however, Chen and Pershing find that the reduction of NO with cyanuric acid will occur to a significant extent if and only if a second reducing agent such as CO is also present. While these observations are very promising and may well prove to be the basis of a very useful process for controlling NOx emissions and thereby reducing acid rain, they are also quite puzzling. If a new NOx control technology is to be developed the chemistry involved must be better understood and this research program was initiated to develop that understanding. This report is the first quarterly report of this research program and covers a period during which the major activity was apparatus setup. Some very preliminary data have, however, been obtained and are discussed herewith. It has been found that, contrary to Perry and Siebers, HNCO does not by itself reduce NO. Their results may be explained as being due to catalytic effects of the stainless steel reaction tube they used. A mechanism which explains the ability of HNCO to reduce NO when CO is present is proposed.

30 (DOE/PC/70771—T9, pp 4.1-4.14) **Results from the inert sorbent calciner program.** [1988]. NTIS, PC A 05. Order Number DE88012962/JAW.

In Kinetics of nitrogen and sulfur reactions in combustion systems: Quarterly report No. 11.

Although the use of calcium based sorbents to adsorb SO_2 in coal fired boilers has been studied extensively in recent years, a complete understanding of the fundamental physical and chemical processes which control the extent of SO_2 capture has not been achieved. Well established theories and previous studies of the sulfation process allow the rates of pore diffusion, external mass transfer, and product layer diffusion to be calculated with some confidence. These processes coupled with the chemical reaction, the unknown physical structure of a calcined sorbent, and the extremely high rate of the overall process (the reaction is primarily over within a few hundred milliseconds) make it difficult to determine which of these mechanisms controls the extent of sorbent utilization. Recent work at EER has determined that the in-situ porosity of a sorbent determines the overall extent of SO_2 capture. Work

was conducted under this program to understand what parameters control that in-situ porosity of a calcined sorbent.

31 (DOE/PC/70771—T9, pp 5.1-5.19) **Sulfation in combustion systems.** Sarofim, A.F.; Longwell, J.P. [1988]. NTIS, PC A 05. Order Number DE88012962/JAW.

In Kinetics of nitrogen and sulfur reactions in combustion systems: Quarterly report No. 11.

The use of natural limestones for the study of high temperature sorbent sulfation is limited by three major factors. The small pore sizes slow down the diffusion of gases to the interior of the particles. A low porosity will always result in incomplete conversion if one doesn't allow the particles to expand. Finally, in order to understand the sorption mechanism, it is useful to study the effect of different kinds of additives. The possibilities of doing this is very restricted in conventional limestones. The synthetic lime that was used in this work allows them to avoid this problem. It has a high porosity (more than 80%) combined with a low surface area, which will keep the effectiveness factor high. In addition, it is prepared starting from an aqueous solution containing all the desired ions in the correct proportions, together with citric acid. The final solid product, after dehydration and air calcination, contains the initial ions in well-dispersed oxide form. Results for pure CaO and with Cr_2O_3 and Na_2O additives are given. Also a simple grain model was developed for describing the conversion versus time plots produced by the TGA. This model and future work are described.

32 (DOE/PC/79798—T5) **LIMB Demonstration Project Extension: Quarterly report No. 4, February, March and April 1988.** (Babcock and Wilcox Co., Barberton, OH (USA). Contract Research Div.). 15 Jun 1988. Contract FC22-87PC79798. 34p. NTIS, PC A03/MF A01. Order Number DE88017218/JAW.

LIMB Demonstration Project Extension progress for February, March, and April, 1988 is in Phase 1 -- Design and Permitting and Phase 2 -- Coolside/LIMB Construction, Start-up and Shakedown. In accordance with the Cooperative Agreement, the Phase 1 40% Completion Review was held at the Barberton facilities of Babcock and Wilcox on April 28, 1988. Representatives of DOE, EPA, the State of Ohio, B and W and Consol were in attendance to discuss Phase 1 progress. Consol has essentially completed technology transfer activities regarding the pilot process simulation tests. Only a report remains to be completed. Detailed design activities continued with the instrumentation of the bypass and humidification chamber. Design of the Coolside sorbent and ash recycle system was emphasized. Consol continues to prepare a report on the waste characterization and run-off simulation studies which are complete. The Environmental Monitoring Plan Outline was issued to the DOE in April, 1988. Under Phase 2 -- Construction, Shakedown and Start-Up, the humidifier lance parts were completed and final assembly was started. Erection of the bypass system flues and humidification chamber was completed. Installation of the instrumentation for the humidifier is under way. Electrical transformers and switchgear are the items of critical importance in maintaining the schedule. 7 figs., 1 tab.

33 **Anaerobic treatment of a biologically inhibitory waste water.** Fox, P.; Suidan, M.T.; Pfeffer, J.T. (Univ. of Illinois, Urbana (USA)). *Journal - Water Pollution Control Federation;* **60**: No. 1, 86-92(Feb 1988). Contract AC21-82MC19352.

A sequence of unit processes consisting of berl-saddle-packed-bed anaerobic reactor and an expanded-bed, granular activated carbon fluidized-bed anaerobic reactor was used for the treatment of a synthetically prepared coal conversion waste water. The waste water, with high concentrations of inhibitory compounds, was fed at three different chemical oxygen demand (COD) concentrations: 1513, 3027, and 7567 mg/L. Excellent removal or organic matter combined with high conversion of COD to methane was achieved. Negligible removal of COD was observed in the packed-bed reactor whereas the expanded-bed GAC reactor was removed in the majority of the organics in the waste water. Ortho- and meta-cresol resisted biodegradation and their toxicity to the anaerobic culture in the GAC reactor was overcome by partial replacement of the granular activated carbon medium in that reactor.

34 **Method of removing nitrogen monoxide from a nitrogen monoxide-containing gas using a water-soluble iron ion-dithiocarbamate, xanthate or thioxanthate.** Liu, D. Kwok-Keung; Chang, Shih-Ger. US Patent Application 6-089,285. 25 Aug 1987. 20p. Contract AC03-76SF00098. NTIS, PC A03/MF A01.

The present invention relates to a method of removing of nitrogen monoxide from a nitrogen monoxide-containing gas which method comprises contacting a nitrogen oxide-containing gas with an aqueous solution of water soluble organic compound-iron ion chelate complex. The NO absorption efficiency of ferrous urea-dithiocarbamate and ferrous diethanolamine-xanthate as a function of time, oxygen content and solution ph is presented. 3 figs., 1 tab.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 2, 52, 528, 823

35 **(PB—88-236872/XAB) Health-hazard evaluation report MHETA 87-173-1882, Jeddo Highland Coal Co., West Pittston, Pennsylvania.** Cornwell, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1987. 17p. (MHETA—87-173-1882). NTIS, PC A03/MF A01.

An evaluation was made of working conditions at the J-44 Strip Mine (Hazelton, Pennsylvania) of the Jeddo Highland Coal Company, West Pittston, Pennsylvania. Concern was voiced over silica dust exposures for highway drill crews during overburden drilling. To reduce operator exposure during this process an enclosed cab was provided for the operator, a rubber skirt was suspended from the deck of the drill to contain the dust, and a collection system conveyed the dust to the ground away from the operator. Respiratory protection was also provided. Quartz was the only form of crystalline silica identified. Personal breathing zone samples indicated a time-weighted average respirable 8-hour dust exposure of 0.8mg/m3 which exceeded the NIOSH recommended standard of 0.05mg/m3. The mass of airborne dust particles that were 10 micrometer in aerodynamic diameter and below, were approximately 69% inside the cab and 45% outside the cab. The cab did afford about a 76% reduction in respirable-dust exposure for the operator. The author concludes that a respiratory health hazard did exist for the drill crew. Engineering controls instituted after this survey resulted in reduction in dust levels.

36 **(PB—88-236906/XAB) Walk-through survey at Pure Carbon Company, St. Mary's, Pennsylvania.** Greife, A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Mar 1983. 19p. (IWS—142.10). NTIS, PC A03/MF A01.

A walk-through survey was conducted to determine whether this facility would be suitable for inclusion in a larger study of the carbon-products industry. At this location, mechanical carbon products were produced such as rings, seals, and bearings from the basic raw materials or calcined petroleum coke and coal tar pitch. Air samples were collected and analyzed for 17 polycyclic aromatic hydrocarbons (PAHs), the highest concentrations of which were found in the baking area. It was not possible to identify the source of these PAHs in this area as 16 of the 17 analyzed for are common to both coal tar pitch and molding-flour bulk samples. Benzene solubles detected in the mixing and baking areas ranged from 0.05 to 0.22 mg/cu m. The workforce at the installation consisted of about 370 persons in three workshifts. Each employee underwent a preemployment physical. A relocation program was underway which, when completed, would significantly reduce employee exposure to coal tar pitch volatiles. The author concludes that this facility is not suitable for inclusion, since petroleum pitch is not used.

37 **(PB—88-236914/XAB) Walk-through survey at Airco Carbon, St. Mary's, Pennsylvania.** Greife, A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Mar 1983. 22p. (IWS—142.11). NTIS, PC A03/MF A01.

An on-site visit was made to Airco Carbon, a producer of carbon products, to gather data concerning the feasibility of using this facility in an industry-wide industrial-hygiene and epidemiology study of the carbon-products industry. Two different product lines were manufactured at this facility: specialty graphite products, and graphite electrodes. Raw materials for both lines included petroleum coke, coal tar pitch, and petroleum pitch. Airborne samples were shown to contain 17 polycyclic aromatic hydrocarbon (PAH) compounds; all of these compounds were listed as tumorigenic and several were positive animal carcinogens. Overall levels of the compounds were low. The areas of the facility involved in formulation and baking appeared to have the highest overall concentrations. Ventilation appeared to be effective in reducing these levels. The author concludes that this particular facility is not suitable for inclusion in the larger project because it is impossible to identify a population of workers with an exposure of adequate duration to only petroleum pitch.

38 **(PB—88-239132/XAB) US coal use: the environmental challenge.** Princiotta, F.T. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Aug 1988. 30p. (EPA—600/D-88/149). NTIS, PC A03/MF A01.

Although this paper focuses on past (since 1920) and current coal use and pollutant emissions in the U.S., it also discusses where the U.S. may be going in terms of pollutant emissions over the next several decades. Conclusions of the look at coal use include the fact that increasing coal use is vital to the economic wellbeing of the US. With proper application of controls, coal use can be increased as projected without unacceptable levels of sulfur and nitrogen oxides, particulate, and nitrous oxide. However, the forecast is bleaker for carbon dioxide and its projected impact on global warming. Barring a technology breakthrough of major proportions (e.g., successful commercialization of nuclear fusion or solar electric generation), the best that can be envisioned is to moderate carbon dioxide emissions from the combustion of coal and other fuels through conservation.

0120 Mining

39 **(DOE/EIA—0125(88/2Q)) Coal distribution, January-June 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 13 Oct 1988. 89p. NTIS, PC A05/MF A01 - GPO. Order Number DE89001587/JAW.

This report provides information on coal production, distribution, and stocks in the United States to a wide audience including Congress, federal and state agencies, the coal industry, and the general public. This issue presents information for January through June 1988. Coal distribution data are shown by coal-producing district of origin, consumer use, method of transportation, and state of destination. 6 figs., 33 tabs.

40 **(NP—9770088) Method for balancing resources in the planning of schedules and capacities of mining operations.** Labitzke, K. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 14 Feb 1986. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770088/JAW.

The winning schedule of a mine is the central factor determining its operation. Complex interdependences with regard to time, location, and equipment must be taken into account. The author presents a concept for integrated planning of schedules and capacities; as a planning aid, he proposes a method for a quasi-optimum balancing of resources. The method is based on the PDM method; it is tested for a few exemplary applications. (HAG).

41 **(PB—88-237565/XAB) MULSIM/BM: a structural analysis computer program for mine design. Information Circular/1988.** Beckett, L.A.; Madrid, R.S. (Bureau of Mines, Denver, CO (USA). Denver Research Center). 1988. 313p. (BM-IC—9168). NTIS, PC A14/MF A01.

For system on magnetic tape, see PB—88-129465. Supersedes PB—88-129473; Library of Congress catalog card no. 87-600293.

This report contains the final user's guide for the MULSIM/BM computer program which is an improved program using the boundary-element approach for geomechanical analysis of mine plans in single or multiple coal seams. The report presents the improved features of the MULSIM/BM program including ability to specify up to 26 material property sets, a new material model capability for gob and inserted materials such as packwalls or cribs, ability to model a large area with a grid of undivided blocks and to subdivide only a specified fine-mesh portion of these blocks into elements, and specification of extraction ratios for the undivided blocks. In addition, an interactive graphics mesh generator program was written to accompany MULSIM/BM. The report contains the user's guide and program listings.

42 **(STEV-TORV—88-10) Computer aided planning of peat transports.** Ringsberg, K.; Ehrning, U.; Areblom, P.A. (ILAB-Industriell Logistik AB, Moelndal (SE)). (Statens Energiverk, Stockholm (Sweden)). Apr 1988. 126p. (In Swedish, English). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755091/JAW.

Analysis has been carried out covering all phases of handling of milled peat and sod peat. The construction of a computerized model for production and transport is described. (G.B.).

0130 Transport And Handling

REFER ALSO TO CITATION(S) 39, 55, 56, 57, 58, 59

43 (EPRI-P—5993, pp 20.1-20.21) **Railroad and coal shipper relationships: the next generation.** Heller, J.N. (Fieldston Co., Inc., Washington, DC (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

An analysis of modern railroad-coal transportation relationships begins in October 1980 with passage of the Staggers Rail Act. The Act altered the relationships between railroads and coal shippers, relieving many regulatory constraints, and thrusting carriers further into the competitive arena. This paper discusses the major changes affecting coal shippers; the performance of railroads since the Staggers Act; the effect of productivity gains on unit train coal shippers; trend in rail rates; importance of utility coal shippers to railroad earning; types of coal transportation contracts; and the role of the ICC.

44 (EPRI-P—5993, pp 26.1-26.3) **Pennsylvania Power and Light Company utility railroad transportation in the 1980s.** Snyder, C.S. (Pennsylvania Power & Light Co., Allentown (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

This paper describes the cooperation of Conrail and the PP and LC after the utility received a favorable ruling from a complaint case before the ICC. Improved scheduling of utility unit trains to shorten delivery time and minimize double handling at the station eliminated the need for freeze protection agents and thaw sheds. An average of 7 round trips per train per month was attained compared with 2 round trips for a typical Conrail coal car. Using the unit trains to move third-party coal westward gained extra revenues. Also the utility started using Conrail for hauling fly ash and bottom ash to buyers, gaining revenues and avoiding disposal costs. Plant sampling has been eliminated. An independent tester now performs analyses at the loading sites.

0140 Combustion

REFER ALSO TO CITATION(S) 1, 8, 25, 32, 384, 823, 2672

45 **(CONF-881120—4) Coal combustion system analysis for carbon dixode recovery.** Berry, G.F.; Wang, C.S.; Dennis, C.B.; Wolsky, A.M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012054/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

The relative size and composition of gas streams concomitant with a new method of carbon dioxide recovery are described and related to each other. This is done for two variations, dry recycle and wet recycle, of the new method. Calculations performed under the differing assumptions of complete combustion and chemical equilibrium are compared. The following fuels are considered: methane, CH_4; Wyodak Coal, CN/sub 0.013/H/sub 1.675/O/sub 0.606/S/sub 0.004/; and Black Thunder Coal, CN/sub 0.019/H/sub 1.599/O/sub 0.539/S/sub 0.003/. The purity of carbon dioxide from the system exit, the recycle fraction of combustion products, the oxygen concentration at the furnace inlet and outlet, and the excess oxygen at the furnace inlet are investigated.

46 **(DOE/MC/22190—2356) Pressurized fluidized-bed combustion: Supplement to report on work carried out at the Coal Utilization Research Laboratories, Leatherhead, England: Final report.** Hoy, H.R.; Roberts, A.G.; Stantan, J.E.; Wilkins, D.M. (Hoy Associates, Fetcham (UK)). Oct 1986. Contract AC21-85MC22190;AC21-80MC14129. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE87006485/JAW.

Equations are derived for predicting sulphur retention, combustion efficiency and heat transfer coefficients in pressurised fluidised-bed combustors. The data are based on published results obtained from various NCB (CURL) combustors and from the IEA Grimethorpe combustor. Additional data on sulphur retention from Exxon, Argonne, and Curtiss-Wright combustors are utilised. In the absence of experimental investigations, the data are also used to predict the possible effect of recycle on sulphur retention. The operating conditions forming the data base are tabulated. 29 refs., 4 figs., 27 tabs.

47 **(DOE/PC/70775—T2) Synthetic chars for the study of char combustion mechanisms.** Flagan, R.C. (California Inst. of Tech., Pasadena (USA)). 1988. Contract FG22-84PC70775. 33p. NTIS, PC A03/MF A01. Order Number DE88015633/JAW.

A method for synthesizing uniformly sized spherical particles of glassy carbon has been developed. The porous microstructures and sizes of the particles can be controlled over a wide range, and the particle composition is much simpler than is typical of chars derived from natural fuels, making these materials ideal for the study of the role on intraparticle diffusion in the oxidation of porous chars. These char particles have been characterized with respect to their morphology, porous microstructure, chemical composition, and crystal structure. The oxidation kinetics have been studied by thermogravimetric analysis, single particle pyrometry observations in a drop tube furnace, and by gravimetric studies of partially reacted samples of chars burned in the drop tube. Studies of the porous structures of the chars reveal a dramatic increase in the surface area early in the combustion process. This increase of as much as two orders of magnitude of the area available for reaction increases the oxidation kinetics. The intrinsic rates of char oxidation were inferred from the experimental data using a pore diffusion model. The rates have similar structure as those previously reported for pyrolytic graphite, with a maximum in the rate above about 2000 K. 16 refs., 7 figs., 6 tabs.

48 **(DOE/PC/79916—1) Determination of local radiative properties in coal-fired flames: Technical progress report, September 15, 1987--March 15, 1988.** Menguc, M.P.; Altenkirch, R.A.; Agarwal, B.; Bush, M.; Subramaniam, S. (Kentucky Univ., Lexington (USA). Dept. of Mechanical Engineering). 1988. Contract FG22-87PC79916. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88011160/JAW.

In order to study the interaction of radiation with combustion or turbulence in combustion systems, we have to know the medium radiative properties as accurately as possible. One of the main goals is to develop an analytical procedure to determine the "effective radiative properties" of cylindrical axisymmetric, inhomogeneous, absorbing, and anisotropically scattering clouds using the data from line-of-sight measurements. These "projection data" will be reduced to determine the local, effective scattering and extinction cross sections, and the scattering phase function of particles. The data reduction scheme is based on the solution of the inverse radiation problem. The inverse radiation problem is to be formulated and solved by considering the physical system. For an absorbing, emitting, and anisotropically scattering pulverized-coal flame, the system to be considered is cylindrical and axisymmetric, but nonhomogeneous. If the medium is not scattering, the solution of the inverse problem is obtained from the Abel integral equation. For a scattering medium, however, there is no inverse solution technique available in the literature. A new technique, angular tomography, can be used for such a system provided that the medium is not a multiple scattering one. The formulations of the inverse solution techniques will be discussed. 60 refs., 8 figs.

49 **(DOE/PC/80752—T13) Detailed model for practical pulverized coal furnaces and gasifiers: Quarterly technical progress report No. 10, May 1, 1988-July 31, 1988.** Smith, P.J.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 31 Aug 1988. Contract FG22-85PC80752. 34p. NTIS, PC A03/MF A01. Order Number DE88017296/JAW.

On May 1, 1985, work was initiated on a contract sponsored by a consortium of industrial and governmental agencies aimed at development of a practical, 3-D coal combustion model. The general objective of this study is to improve and extend a generalized two-dimensional, pulverized coal combustion and gasification code for application to large-scale, practical configurations, and to evaluate and implement the resulting code on an industrial scale. This report summarizes work conducted during the first quarter of the fourth year (thirteenth quarter) of this contract. A summary of work accomplished during this quarter is given by task and includes only tasks where significant progress was made during this quarter. 41 refs., 8 figs., 3 tabs.

50 **(DOE/PC/90753—T9) Coal ash deposition, interaction with metal substrates and deposit build up: Summary for period May 26-August 25, 1988.** Birks, N. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 1988. Contract FG22-86PC90753. 4p. NTIS, PC A02/MF A01. Order Number DE89001978/JAW.

The objective of this program is to characterize the attack of the metal substrate subsequent to the deposition of ash and incompletely transformed ash minerals under oxidation/sulfidation environments and at high temperature. In the absence of authoritative knowledge concerning the transformation route by which a coal mineral reacts to become an oxide constituent of the ash, it was decided to represent the ash or partly converted minerals using appropriate ternary systems based on potassium, sodium, calcium, silicon and magnesium oxides in which low melting eutectics are formed, referred to in this work as "slags". Untransformed or incompletely transformed minerals can also act as a direct source of sulfur and as a direct cause of transient liquids when placed on metal substrates under an oxidation/sulfidation environment. In this way, it is intended to simulate the initial deposition of ash, oxide formation on the metal, bonding between ash and substrate, liquid layer formation and corrosive attack of the underlying metal surface.

(TAE—606) Coal particle behaviour in a countercurrent combustor. Libbis, N.; Hazanov, Z.; Goldman, Y.; Greenberg, J.B.;. Timnat, Y.M. (Technion-Israel Inst. of Tech., Haifa). Jan 1987. 40p. NTIS, PC A03/MF A01.

The gas-phase using the two equation turbulence model, which is solved for a domain corresponding to the experimental conditions, using a uniformly-spaced grid and appropriate boundary conditions is presented. Theoretical distributions of axial and radial velocity, and axial pressure and temperature are shown. The experimental procedure is then treated in detail, presenting the combustor employed and discussing the determination of gas velocity, temperature and concentration, with particular attention to the instruments used and the effects of turbulence and misalignment. The experimental results covering measurements performed with a cyclone section showed that combustion has a strong influence on the velocity distribution, narrowing considerably the radial component and accentuating the effect of the reverse flow. The temperature starts to rise fast after 20 cm and reaches a maximum of 1420 K after 30 cm for low flow rate, arriving at 1700 K at 35 cm for high flow rate. These measurements, together with the axial and radial distribution of the permanent components point to a fast turbulent reaction, with a sizeable cooling effect caused by the entrance of air downstream.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 39, 43, 44, 61

52 **(ANL—9001719) Regulations influencing the introduction of coal-derived fuels into industrial, commercial, and residential markets.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Coal Utilization, Advanced Conversion and Gasification). Oct 1986. Contract W-31109-ENG-38. 220p. NTIS, PC A10. Order Number DE89001719/JAW.

This report describes and organizes regulations that pertain to the introduction of coal-derived fuels into the light industrial, commercial, and multifamily residential markets. The scope of the work has included collecting the federal, state, and local regulations that might affect the introduction of new coal-using technologies into 12 selected markets. This report emphasizes local, or city-specific, regulations. Federal regulations are discussed because in many areas they form the basis for both state and local regulations, and are sometimes adopted in their entirely for application at state and local levels. In our analysis of the regulations collected in this study, we identify those local regulations that are likely to be significant in controlling the introduction of a coal-based fuel technology suitable for space and water heating. The discussion highlights the requirements that differ from the more generally understood and better-known federal laws and the state regulations derived from them. In our examination of local regulations, we have assumed that the most likely form of fuel would be coal, and that it would be burned in boilers with capacities from 1 {times} 10^6 to 100 {times} 10^6 Btu per hour. The coal would most likely be transported to the end-user site by truck. However, both liquid and gaseous coal-derived fuels were also considered in the collecting and analysis of regulatory material, and special effort was made to identify regulations controlling the transport, use, and storage of hazardous materials.

53 (EPRI-P—5993, pp 13.1-13.6) **Price outlook for the US coal industry.** Karis, W.G. (Consolidation Coal Co., Pittsburgh, PA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

The highly competitive structure of the coal industry will ensure that market prices in the future will continue to follow production costs. Margins on market priced sales will have to recover from today's depressed levels (by historical standards) if the coal industry is to undertake the capital investment required to meet the anticipated growth in coal demand. The rate of margin recovery will be mitigated by the gradual depletion of current excess industry production capacity and by continued growth in industry productivity. Oil prices are not expected to be a significant factor affecting market prices for coal. Natural gas, on the other hand, may be more of a long-term competitive threat to coal in selected market areas because of the substantially lower capital cost and shorter lead time requirements for building new sources of power generation fueled by gas versus coal. It is the author's opinion, however, that the long-term availability of natural gas and/or the long-term outlook for real price escalation for natural gas will limit competition between natural gas and coal for new electric power generation. Thus, market prices for coal, at least for the foreseeable future, will be guided almost exclusively by competition within the coal industry. The only wild card is the possibility of acid rain legislation. In which case, all bets are off.

54 (EPRI-P—5993, pp 14.1-14.15) **EPRI fuel forecast review update.** Oliva, L.; Kennedy, L. (Putnam, Hayes & Bartlett, Inc., San Francisco, CA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

As part of an EPRI research program Fuel Forecast Review and Analysis RP2369-20, Putnam, Hayes & Bartlett, Inc. (PHB), has collected, analyzed, and placed in a computerized data base forecasts of fuel prices, supply and demand by many prominent energy forecasters. At present, the data base contains 35 fuel forecast categories with projections by 21 different forecasters. In addition, a series of forecast analyses and reviews of forecast updates has been produced. This summary review compares and contrasts the projections of a series of forecasts covered in the EPRI review program. The interest here is in understanding how and why opinion change and how much uncertainty exists, on a relative basis, at a given point in time. Forecast outputs are driven by inputs, and this review discusses those effects to the extent to which causality can be discerned from the examination of the published sources. All of the data presented in this update were taken from the EPRI data base and analyses. The forecasters selected for this review were chosen because they are widely and highly regarded, they produce forecasts for a range of fuels, and because they have produced forecasts in a consistent format over time which facilitated comparison across fuels and historical periods. Crude oil, residual oil, coal, and natural gas prices are forecast. Also forecast are the ratio of gas and crude oil prices, ratio of gas and residual oil prices, and ratio of gas and coal prices.

55 (EPRI-P—5993, pp 21.1-21.21) **Coal transportation rates under acid rain legislation.** Hewson, T.A. Jr. (Energy Ventures Analysis, Inc., Arlington, VA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

This paper examines the determinants of coal transportation rates and estimates likely future high and low-sulfur coal transportation rate ranges to power plants potentially affected by acid rain legislation. This analysis is based upon EPRI project 2369-53, prepared by Energy Ventures Analysis (EVA) and its subcontractor A. T. Kearney. Kearney provided transportation rate ranges for an initial sample of 89 plants and the analysis of how some transportation rate factors (e.g., railroad mergers, carrier cost and pricing) would not significantly change to affect rates over the next 10 years. EVA developed the remaining transportation rates and the analysis of transportation rate differentials created by coal switching. Transportation costs are the most significant factor in determining within a utility system the order in which the stations would switch to low-sulfur coal. This is because FOB mine prices for low-sulfur coal should be approximately the same for stations within a given utility system, but the delivered costs will vary significantly based upon the station's locations, mode of delivery and carrier involved. The same is true for high-sulfur coal. High-sulfur FOB mine prices are usually comparable for a given utility system, and the transportation costs will determine the ranking of high-sulfur coals. With a relatively fixed FOB mine price differential between high and low-sulfur coals, it will be the transportation cost differential that will show the greatest variation within a specific utility system. The greater this transportation differential, the greater the costs of switching to a low-sulfur coal.

56 (EPRI-P—5993, pp 22.1-22.5) **Railroad marketing to electric utility customers.** Flanagan, K.M. (Burlington Northern Railroad Co., Fort Worth, TX (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

The paper begins with an overview of the changes underway in both the railroad and electric utility industries. Past negotiating practices are also reviewed. The paper then discusses innovative equipment and methods used in railroad marketing with electric utilities, i.e., aluminum cars, precision loading systems, cycle time guarantees, tailoring deals to alternative sales competition and off-system sales opportunities, selling off the stockpile, blending, and flexibility for utilities with multiple plants.

57 (EPRI-P—5993, pp 23.1-23.7) **Flexible, aggressive action by utilities can lower coal delivery costs.** Murrell, F.J. (Lane, Trohn, Clarke, Bertrand & Williams, Lakeland, FL (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

In today's transportation environment, it is essential to understand transportation and source options, develop the maximum amount of flexibility, and utilize these options to lower transportation costs. As coal prices approach their economic floor, transportation costs offer an opportunity to continue to reduce the delivered cost of coal to power plants. The prudent utility official will continue to enjoy cost reductions even after the cost of minemouth coal has reached an equilibrium point. This paper describes the qualities of a good coal procurement department and discusses various options for the delivery of coal to a power plant, the use of cost consultants, and contract clauses.

58 (EPRI-P—5993, pp 24.1-24.14) **Coal contract renegotiations.** Tye, W.B. (Putnam, Hayes & Bartlett, Inc., Cambridge, MA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

Recent trends in the rail and coal industries have created opportunities for negotiations of new contracts and renegotiations of old contracts in the interest of coal buyers. Lower prices for coal, and in some cases rail, create obvious opportunities where new contracts may be signed at more favorable terms than in the recent past. In many cases both parties to a coal supply agreement can benefit when existing contracts are renegotiated. Changing circumstances have also occasionally created litigation over the terms of existing contracts. Resolution of these contract disputes represent opportunities for both parties to benefit from the situation. Coal buyers and suppliers and coal-hauling railroads need to be aware of these changing circumstances and opportunities so that wise coal transportation and coal contract decisions can be made.

59 (EPRI-P—5993, pp 25.1-25.6) **In search of competition.** Barthlow, N.H. (Detroit Edison, MI (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

Almost all Detroit Edison coal is moved by large volume unit trains. There are two transportation networks in place, with a third now being developed. These are the Eastern (covering Appalachia), the Western (covering the Powder River Basin) and, the third, the midwestern (covering the Illinois Basin). These are complex integrated networks. Detroit Edison has developed an integrated approach to fuel planning and procurement that provides not only for competition, but its own arena in which to operate. This approach is discussed in three segments: (1) the strategies, (2) the search and (3) the arena of Competition. To protect the confidential integrity of their ongoing programs, the following discussion is somewhat generic. Nevertheless, the lines and the examples given should convey how Detroit Edison goes about generating an arena of competition. Not all the ideas are new, but I think you will find many original as well as provocative.

60 (PB—88-231667/XAB) **Causes of coal-miner absenteeism. Information Circular/1987.** Peters, R.H.; Randolph, R.F. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). Jan 1987. 52p. (BM-IC—9161). NTIS, PC A04/MF A01.

Library of Congress catalog card no. 87-600232.

The Bureau of Mines report describes several significant problems associated with absenteeism among underground coal miners. The vast empirical literature on employee absenteeism is reviewed, and a conceptual model of the factors that cause absenteeism among miners is presented. Portions of the model were empirically tested by performing correlational and multiple regression analyses on data collected from a group of 64 underground coal miners. The results of these tests are presented and discussed.

0160 Health And Safety

61 (PB—88-234257/XAB) **Determining the effect of incentive programs on the occurrence of accidents, injuries, and productivity - final report. Open File Report 20 January 1984-31 December 1987.** Goodman, P.S. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Graduate School of Industrial Administration). Dec 1987. 143p. NTIS, PC A07/MF A01.

This report examines the effectiveness of bonus plans in the coal industry. The analysis uses theoretical, literature review, and empirical approaches to determine the impact of bonus plans on safety and productivity in underground coal mines. The basic finding is that the modal bonus plan in underground coal mining does not have a major impact on productivity and safety indicators. The design of the plan, or organizational factors, and the process of introducing the plan all contribute to its relative ineffectiveness. Strategies and options for designing effective plans are presented.

62 (PNL—6500-Pt.1, pp 63-66) **Molecular markers during development.** Springer, D.L. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The initiating activity of two high-boiling, coal-derived complex organic mixtures were compared, using the rat hepatic gamma-glutamyl transpeptidase and mouse-skin models. One-day-old rat pups were treated by intraperitoneal injection to initiate the development of neoplastic changes in their livers. These animals were placed on a synthetic diet containing phenobarbital at 3 weeks of age and were maintained on the diet for 10 weeks. Mice were treated at 10 weeks of age by dermal application of the test materials and tumor development was promoted by twice-weekly applications of tetradecanoylphorbol acetate. Results indicated that the complex organic mixtures were poor initiators of preneoplastic changes in the liver but were very active as initiators of mouse skin tumors. Co-administration of the complex mixtures with the known carcinogens benzo[a]pyrene or dimethylnitrosamine resulted in significantly fewer tumors, in both the hepatic and dermal models, compared to the number of preneoplastic changes observed with the known carcinogens administered alone. These data suggest that tumor-initiating activity is, to a large degree, determined by the matrix in which it is administered.

63 (PNL—6500-Pt.1, pp 67-70) **Molecular control of lung development.** Mast, T.J. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

Coal-derived liquids have previously been shown to be teratogenic when pregnant rats or mice were exposed to these complex mixtures (CM) by either inhalation, oral, or dermal routes. Pulmonary hypoplasia is a major abnormality induced in the offspring of pregnant rats exposed to this CM. In order to provide a framework for further research into the molecular mechanisms regulating pulmonary maturation, this study on the temporal development of fetal lungs in control and CM-treated fetuses was undertaken. When compared to those of controls, hypoplastic lungs were not only much smaller but had less organization in the interstitial tissue and also had increased septal thickness. Although bronchial and bronchiolar regions of the hypoplastic lungs appeared normal, these

data indicate that functional impairment may result from abnormal development of the alveloar region. The similarity between the overall effects of the glucocorticoid treatment and those noted as a result of treatment with CM may imply a common mechanism. Results of this study will be used as a basis for future work intended to elucidate the molecular mechanisms regulating lung maturation and differentiation.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 52

02 PETROLEUM

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 1768, 2000

64 **(DGMK—298-2) Genesis of hydrocarbons with anomalous methane isotope ratios desorbed from rocks.** Faber, E.; Gerling, P.; Dumke, I. (Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). Jan 1988. 41p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

Hydrocarbon gases were found in considerably high quantities with an unusual composition in granites from the Oberpfalz area: δ/sup 13/C/sub 1/ = ca. - 23per mille PDB, δD/sub 1/ < -750per mille SMOW, C/sub 2/H/sub 4/ > 7 Vol%, C/sub 3/H/sub 6/ > 5 Vol%, H/sub 2/-gas (qualitatively determined). These gases were presumably generated during drilling into the granite rocks at high mechanical pressure and temperature. The hydrocarbon precursor materials reactions are not presently known. The gases have also been found in smaller quantities in sediment samples which also contained biological (bacterial, thermal) hydrocarbon gases. Models have been developed to estimate the genetic character of the biological gas component from the mixture data of most of the samples. (orig.) With 13 figs., 3 tabs., 22 refs.

65 **(DGMK—406) Facies and palaeoenvironment of the Sannois-Fischschiefer (North Alpine Molasse Basin, Bavaria, South Germany). An integrated sedimentological-geochemical-statistical study of the lateral facies development of a potential source rock.** Gerhard, J. (Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)). Apr 1988. 196p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

53 Core samples of a potential source rock (Sannois Fischschiefer; North Alpine Molasse Basin) were analysed for a study of the relationship between sedimentological, paleontological and geochemical parameters to get valuable informations about the environment at the time of deposition. Combined analyses (distribution of minerals, granulometry, micropaleontology, organic petrography, inorganic and organic chemical analyses, and electron paramagnetic resonance) are used to get the necessary datas for statistic analyses. To explain the genesis of the high organic carbon content it was necessary to estimate paleoproductivity, sediment- and TOC-accumulation rates. All of these values are relatively low and comparable to the Black Sea. Sedimentological and geochemical features, as well as fauna and flora, support the distinction of 3 facies areas. Using the relationships between paleoproductivity, sediment-accumulation-rate, inorganic guide elements (Cr, Cu, Ni, V, Mo, U, Zn), ESR-properties and organic parameters, it is possible to determine the paleoenvironmental conditions of sedimentation and to get informations about the source-rock potential. (orig./RB) With 18 tabs., 58 figs.

66 **(PB—88-235692/XAB) Delineation of oil and gas fields using a high-resolution electrical technique.** Zonge, K.L. (Zonge Engineering and Research Organization, Tucson, AZ (USA)). Jul 1985. 95p. NTIS, PC A05/MF A01.

Surface field measurements of apparent resistivity and phase difference were made along eight lines crossing two gas fields in Oklahoma and California in an attempt to detect subtle electrical alteration in the sediments above the fields. In one case a subtle, narrow resistivity anomaly was detected, which may be associated with the fault trapping the hydrocarbons. In the other case, a stratigraphic example, a very weak-phase anomaly was detected, but correlation of this anomaly with the field is tentative. In the event that these tentative findings can be verified, the controlled source audio-frequency magnetotellurics (CSAMT) technique would prove to be extremely beneficial to the oil and gas industry, in that the technique is a rapid, low-impact, inexpensive exploration tool.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 102, 1331, 1332

67 **(DOE/FE/61445—T2) Reservoir analysis study: Naval Petroleum Reserve No. 1, Elk Hills Field, Kern County, California: Phase 3 report, Recommended additional reservoir engineering analysis.** (Bergeson (Jerry R.) and Associates, Inc., Golden, CO (USA)). Jul 1988. Contract AC01-88FE61445. 258p. NTIS, PC A12. Order Number DE88015794/JAW.

The basis for completion of the Phase III tasks above were the reports of Phases I and II and the associated backup material. The Phase II report was reviewed to identify the major uncertainties in all of the reserve assignments. In addition to the Proved, Probable and Possible reserves of Phase II, "potential reserves" or those associated with a greater degree of risk than the Possible reserves included in the Phase II report, were also identified based on the work performed by Bergeson through the Phase II reporting date. Thirty-three specific studies were identified to address the major Phase II reserve uncertainties or these potential reserves. These studies are listed in Table 1 and are grouped by the Elk Hills pool designation. The basis and need for each study are elaborated in the discussion which follows. Where possible, the need for the study was quantified by associating the study with a particular reserve estimate which would be clarified by the analysis. This reserve value was either the Probable or Possible reserves which were being studied, the potential reserves that were identified, or simply the uncertainty inherent in the proved reserves as identified in the study purpose. The costs associated with performing the study are also shown in Table 1 and were estimated based on Bergeson's knowledge of the Elk Hills reservoirs and data base following Phases I and II, as well as the company's experience in performing similar studies in other fields. The cost estimates are considered reasonable for general budgeting purposes, but may require refinement prior to actual initiation of these studies. This is particularly true for studies involving field testing to obtain additional log, core or test information as the cost of such items is not considered in this report. 51 figs., 46 tabs.

68 **(DOE/FE/61445—T3) Reservoir analysis study, Naval Petroleum Reserve No. 1, Elk Hills Field, Kern County, California: Phase 3 report, economic development and production plan.** (Bergeson (Jerry R.) and Associates, Inc., Golden, CO (USA)). Jul 1988. Contract AC01-88FE61445. 303p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88016098/JAW.

Jerry R. Bergeson and Associates, Inc. (Bergeson) has completed Phase 3 of the Reservoir Analysis, Naval Petroleum Reserve Number 1, Elk Hills Oilfield, California. The objective of this phase of the study was to establish the economic potential for the field by determining the optimum economic plan for development and production. The optimum economic plan used net cash flow analysis to evaluate future expected Department of Energy revenues less expenses and investments for proved developed, proved undeveloped, probable, possible and possible-enhanced oil recovery (EOR) reserves assigned in the Phase 2 study. The results of the Phase 2 study were used to define future production flowstreams. Additional production scheduling was carried out to evaluate accelerated depletion of proved developed reserves in the 29R, 31 C/D Shale and Northwest Stevens T Sand/N Shale Reservoirs. Production, cost and investment schedules were developed for the enhanced oil

recovery projects identified in Phase 2. Price forecasts were provided by the Department of Energy. Operating costs and investment requirements were estimated by Bergeson. 4 figs., 48 tabs.

69 **(IFP—35-845) Comparative study of thermodynamic properties of mixtures of light crude with various injection gases. Application to the optimal choice of an enhanced recovery agent.** Benahmed, A. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). Dec 1987. 261p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88754979/JAW.

Knowing the thermodynamic properties of one crude oil in presence of conventional gases (C0/sub 2/, methane, rich gas) or not (nitrogen, flue gas) is absolutely necessary for understanding the physical and chemical mechanisms involved in the field of enhanced oil recovery by miscible gases injection. The present research work was realized with synthetical crude oil "North Sea Type" called here after AH1, at 103/sup 0/C field temperature. After oil "AH1" alone classic PVT study, the same measures were carried out with various mixtures of "oil + gas injection". The swelling of light oils by the five injection gases is significant and can reach very high values mainly in the case of hydrocarbon gases (swelling of 60 % for 20 % "rich gas" weight concentration). Some mixtures "AH1 + gas" liquid-vapor equilibrium quantitative study was undertaken. Then, displacements were carried out in porous medium with different gases for determining minimum miscibility pressures and study recovery mechanism. Finally, numerical simulations of the thermodynamic properties of "AH1" oil and its mixtures with injection gases by SBR equation of state were carried out and good agreement was obtained.

70 **(NP—9770085) Phase transition characteristics of multicomponent systems of saline water, petroleum, and nonionic amphiphiles.** Wachsmann, V. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 4 Feb 1987. 122p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89770085/JAW.

The phase transition characteristics of quasiternary systems of electrolyte solution, nonionic amphiphile, and petroleum were investigated with a view to their importance in enhanced petroleum recovery. Nonionic amphiphiles and mixtures of nonionic and anionic components were investigated with a view to the formation of a middle-phase microemulsion under deposit conditions, using oil and formation water from the Vorhop-Knesebeck deposit. A number of tensides and tenside mixtures were found which resulted in the desired formation of an inverted-phase microemulsion in high-salinity water and at higher temperatures, without requiring cotenside additives. The phase inversion temperature, which depends on the HLB value, was found to be a phase indicator. Physicochemical studies were carried out on equilibrium phases and on the overall water-oil-tenside system in order to characterize the physico-chemical phenomena accompanying the phase transition behaviour of these systems. The middle-phase microemulsion in the inverted phase remains stable over a wide range of temperatures and salinities. Core flooding experiments showed that a Type III phase equilibrium state according to Winsor mobilizes the residual oil and results in oil bank formation with high oil extraction efficiencies.

71 **(RISO-M—2729) EFP basic reservoir simulation program COSI. Description of a new input facility.** Reedtz Funder, C. (Risoe National Lab., Roskilde (Denmark)). May 1988. 230p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755066/JAW.

This report first presents a users guide to 'KIP', a generally applicable system for the programming of keyword based input modules especially for programs requiring substantial amounts of input data. The system leads to a very clear arrangement of the input and makes changes and extensions of the input module very easy. Furthermore it offers very flexible facilities for array input. Secondly a new input facility for the EFP basic reservoir simulator 'COSI' is described. This simulator is applicable to all common oil and natural gas production techniques. The new input facility, based on the general programming system KIP, is described in terms of both a users guide and a programmers guide.

72 **Economic evaluation of a CO/sub 2/ EOR flood at the Rock Creek Field, Roane County, West Virginia.** Brummert, A.C.; Ammer, J.R.; Watts, R.J.; King, P.; Boone, D.A. (U.S. DOE Morgantown Energy Tech. Center, Morgantown, WV (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **3**: No. 3, 829-834(Aug 1988).

The U.S. DOE Morgantown Energy Technology Center and the Pennzoil E and P Co. predicted the recovery and economic potential of a full-field, CO/sub 2/ miscible EOR flood at the Rock Creek field, Roane County, WV. Data used in this evaluation were obtained from two miscible CO/sub 2/ Rock Creek field tests: (1) a pilot test consisting of two contiguous normal five-spot patterns, each containing 10 acres [4 ha], and (2) a 1.55-acre [0.63-ha] normal four-spot minitest. Core date from the eight injection wells and three observation wells were used to determine reservoir input parameters, and fluid samples were analyzed to obtain fluid properties. A predictive model was used to calculate oil recovery and project economics. The model's base-case run showed that an oil price of $39/bbl[$245/m/sup 3/] was required to produce a 15% discounted cash flow rate of return (DCF ROR). A sensitivity study was then conducted on operating parameters [i.e., pattern size, water-alternating-gas (WAG) ratio, total HCPV of WAG injected, and injection rate] and economic parameters (e.g., oil price and CO/sub 2/ cost) to determine their effect on project performance and project economics.

0204 Processing

73 **(IFP—35-46) Study of the influence of composition and aging of catalysts on dehydrocyclization of n-paraffines in ascending molecular weight and of n-butylbenzene.** Ammour, F. (Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). Sep 1986. 160p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88754982/JAW.

After a review of bibliographic data on paraffine dehydrocyclization on reforming catalysts, chemical reactions, catalysts and catalyst aging by sintering and coking are presented. A detailed description of catalyst preparation and characterization is given and preliminary tests for catalytic activity measurement are presented. A comparative study of dehydrocyclization of normal paraffins with increasing molecular weight on mono P+ or bimetallic (Pt-Re and Pt-Sn) catalysts with different coke ratio is presented. Results show that dehydrocyclization rate is increasing with the number of carbon atoms especially at low hydrogen pressure. Inhibiting effect of the aromatic cycle is evidenced. By selective poisoning the distribution between different chemical reactions is established for transformation of n-butylbenzene. 73 refs.

0205 Products And By-products

REFER ALSO TO CITATION(S) 862

74 **(AD-A—195648/1/XAB) Lubricants and lubricant additives under shear studied under operating conditions by optical and infrared spectroscopic methods.** Lauer, J.L.; Ahn, Y. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics). 1988. 9p. NTIS, PC A02/MF A01.

Pub. in STLE Transactions, Vol. 31, No. 1, 120-127(1988).

A physical basis was sought for differences in fuel economy with a typical petroleum lube base stock when various additives were present. The kinematic viscosity was maintained at 7.1 cS at 100C by blending. Film thickness, temperature, and traction were determined for a ball/plate contact under elastohydrodynamic conditions. Different additives produces considerably different results. Invariably, small film thicknesses paralleled low temperatures in the conjunction region, low traction and high fuel economy. Zinc dithiophosphate(ZDDP) was unique in that it always increased film thickness, but increased traction only at high loads and low speeds while decreasing it otherwise. Other additives, e.g. friction modifier(FM) and viscosity index(VI)improver and combinations decreased film thickness and traction. To help determine the rea-

sons for these behaviors--whether surface or bulk effects--polarized infrared emission spectra were collected from an operating mock journal bearing.

75 **(AD-A—195975/8/XAB) Determination of the hydroperoxide potential of jet fuels.** (Coordinating Research Council, Inc., Atlanta, GA (USA)). Apr 1988. 111p. (CRC—559). NTIS, PC A06/MF A01.

In 1963 and in 1976, peroxide attack on certain engine rubber parts was found on some Far Eastern fuels. The problem was corrected by requiring oxidation inhibitor be added to fuels meeting Specifications DERD 2494 and MIL-T-5624. Because the majority of commercial aviation turbine fuel had not shown significant peroxide formation, CRC was requested to develop a technique which would identify the hydroperoxide-forming tendencies of jet fuels. Heating the fuel at 65 C for four weeks and measuring the peroxide number after four weeks is concluded to be an adequate Go/No Go test.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 54, 67, 68, 72

76 **(DOE/EIA—0109(88/08)) Petroleum supply monthly, August 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Oct 1988. 106p. NTIS, PC A06/MF A01 - GPO. Order Number DE89002157/JAW.

Total US demand for petroleum products (measured as products supplied) averaged 17.4 million barrels per day in August 1988. This is over 0.8 million barrels per day above the level for July and over 1.0 million barrels above the level for August 1987. Total product supplied for the first 8 months of 1988 was 2.5 percent higher than during the same period in 1987. Demand for all major products increased in August, with distillate, asphalt and road oil, and residual fuel oil showing the largest gains. Other highlights for August 1988 include: stocks of crude oil, excluding the Strategic Petroleum Reserve (SPR), dropped 16.2 million barrels in August to 333.2 million barrels; total product stocks increased for the second month in a row, rising 9.4 million barrels to 735.4 million barrels; and the US refinery utilization rate increased from 86.5 percent in July to 87.4 percent in August. 12 figs.

77 (EPRI-AP—5937, pp 3.17-3.44) **Emulsions economics for utility boilers.** Osgerby, I.T. Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

Deagglomeration of asphaltene and emulsification of fuel oils with water is very effective in reducing particulates and requirements for excess air with a corresponding reduction in NOx and sulfur trioxide emissions. Both short term and long term economic incentives for emulsification are discussed. Short term incentives explained are reduced excess air and unburned carbon, ash friability, increased vanadium content in fly ash, stack gas gains and losses, and direct costs. Longer term benefits are described under the following headings: furnace cleaning, alternative fuel purchase, and load cut back.

78 (EPRI-P—5993, pp 10.1-10.9) **Strategic fuel planning: world oil geopolitics.** Conant, M.A. (Conant and Associates, Ltd., Washington, DC (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

The causes for uncertainties in strategic fuel supply issues are well-known. In the case of oil they include the impact on oil of quite possibly ill-conceived government actions in raising or depressing prices, the consequences of boycotts or wars upon supplies available to importing consumers; the poor finding rates worldwide for large discoveries; the reduction in oil exploration budgets especially in the US and the effects of these considerations on alternative fuels. Yet all of these factors are met in the normal course of business and most could be dealt with as ordinary commercial circumstances were it not for the single factor of the pervasive role of governments in affecting supply and demand. While governments' role is large in natural gas, coal, and nuclear fuel, it is the still preeminent share of oil in the energy balance of the industrial world which sets the pace (price and volume) for other fuels. This will remain true for another decade or two. There is reason enough to focus on the uncertainties affecting oil and gas supply and demand. Virtually every energy analyst in government and the private sector stresses the need to live with uncertainty as if this were a revealed truth unto itself. To the contrary, while no one can ignore the destabilizing realities in the gas and oil industry, there is a risk that the certainties in the fuel outlook get forgotten. This paper concentrates first on the key certainties, then, on key doubts.

79 (EPRI-P—5993, pp 11.1-11.19) **Crude oil and residual fuel oil in a volatile world market.** Krapels, E.N.; Savy, C.M. (Energy Security Analysis, Inc., Washington, DC (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

When trying to determine the future of the price of fuel oil in the US it must be taken into consideration that oil prices are determined largely by international factors. The US influences world oil prices but not longer sets these prices. Thus, when electric utility executives construct plans requiring anticipation of future oil price movements they unavoidably become analysts of international oil affairs. In doing so, they enter into a complex, dynamic and rich set of activities. In an analysis of any complex set of activities, it is useful to have a broad framework from which to work. The framework used here broadly divides the complexities of the international market into forces generated by three sets of fundamentals of the international petroleum marketplace: the economic force - supply and demand; the political force - the geopolitics of nations involved in oil trade and the implicit rules governing communications between those nations; and the psychological force - the perceptions, fears, and aspirations of individuals and institutions involved in the international oil system. To understand the oil market from day to day and where it will be next month and next year, it is useful - indeed vital - continuously to remember these three forces and to make judgments about their effects on market activity.

80 (EPRI-P—5993, pp 12.1-12.14) **Linkage between global economic developments, fuel costs and financing costs.** Miller, G.S. Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

As an international banker for the past 15 years, the authors contacts with the electricity supply industry were generally very few, and with the US industry almost non-existent. The same can be said for his international banking colleagues. There were good reasons for this state of affairs. It is the object of his presentation to suggest that those past reasons are today declining in significance, and, correspondingly, that international influences on the US electricity supply industry are in the process of becoming increasingly important. The past is briefly reviewed; the current situation and its financial implications are analyzed; and the trend in fuel costs in the future is discussed. It is pointed out that under the US regulatory system, in practice consumers ultimately bear the interest costs anyway, whether fixed or floating, so why should electric utilities risk looking foolish by locking in financing costs which may later look very high? The penalties for getting that sort of thing wrong are far greater than the rewards for getting it right. It is these non-economic but rather political and subjective considerations which also influence the decision-making of everybody else in the world.

81 (LBL—24213, pp 3.41-3.42) **Causes of rising transportation oil demand in the LDCs.** Meyers, S. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

LBL has been engaged in the analysis of energy use in the Less Developed Countries (LDCs) for several years. The LDCs have been the most important source of increase in world oil use since 1973, and the largest source of growth in LDC oil use has been the transportation sector. To better understand the dynamics of growth in this sector, it is necessary to look in detail at the structure of transportation in these major LDCs. LBL gathered data on oil use, motor vehicles, and air travel for a number of LDCs. For 15 major LDCs, combined oil use in transportation increased from 57 to 133 million tons oil equivalent (TOE) between 1970 and 1985. Transportation accounted for half of their total increase in oil use, and its share of total oil use rose from 46% to 49%. The paper discusses the growth in motor vehicle ownership and growth in LDC air transportation.

82 (OCS/MMS—88-0038) **Gulf of Mexico update, July 1986-April 1988: Outer continental shelf oil and gas activities.** (Minerals Management Service, Vienna, VA (USA). OCS Information Program). 1988. 47p. Minerals Management Service, P.O. Box 101159, Anchorage, AL 99510. Order Number TI89001757/JAW.

The offshore segment of the oil and gas industry that operates in the Gulf of Mexico has undergone significant restructuring in the recent past. This restructuring was brought on by the decline in the price of oil and natural gas that occurred during this period. Figure 1 depicts trends in the price of selected benchmark crude oils for the past 7 years and helps illustrate this point. During this time, however, oil and gas continued to comprise a significant portion of the energy feedstocks of the Nation. The Outer Continental Shelf (OCS) currently provides approximately 12 percent of the Nation's oil and 25 percent of its natural gas. The Gulf of Mexico accounts for over 90 percent of domestic production of both oil and natural gas from the OCS. These statistics help to explain the continued interest in the OCS of the Gulf of Mexico during a period of declining prices. Though many unknowns remain, operators have compiled extensive knowledge of the geologic structure of the Gulf of Mexico OCS. This knowledge helps them to minimize losses often associated with drilling in frontier areas. Accordingly, interest in OCS lease sales remains strong as does exploratory and development activity. Reflecting this interest, OCS Lease Sale 113 set a new record for the number of blocks receiving bids. 12 figs., 11 tabs.

83 (PB—88-235825/XAB) **Reducing US import oil dependence by one billion gallons of diesel fuel per year.** Bilanin, A.J.; Williamson, G.G.; Geyer, R.G. (Continuum Dynamics, Inc., Princeton, NJ (USA)). Aug 1985. 64p. NTIS, PC A04/MF A01.

A system of simple plates attached to the aft-end of a Ford Club Wagon passenger van was configured to significantly reduce the base drag of the van. When these results are scaled to tractor/semi-trailers or trailer vans it is shown that vehicle-drag reductions in excess of 10% are possible. Based on the current size of the U.S. semi-trailer van fleet, and yearly over-the-road use estimates, this drag reduction translates into a yearly fuel saving well in excess of 1,000,000,000 gallons. Questions remain unanswered with regard to mechanisms that result in the base drag reduction, as well as performance of the device in a crosswind.

0208 Waste Management

REFER ALSO TO CITATION(S) 96

84 (CONF-871075—Vol.1-Pt.2, pp 27-56) **Large-scale stabilization of hydrocarbon wastes with spent clays and pozzolans.** Martin, J.P.; Robinson, W.T.; Van Keuren, E.L. (Drexel Univ., Philadelphia, PA (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

One alternative for stabilizing a large volume of acid hydrocarbon sludge and spent clay wastes from hydrocarbon refining is to use pozzolans to cement the clay into a porous matrix. Immobilization of hydrocarbon globules would thus be a combination of adsorption, neutralization, and physical entrapment in the pore spaces. The stabilized wastes can then be re-deposited on site in a series of landfills. The thrust of the investigation is to optimize the proportioning of sludge, clay, fly ash and hydrated lime. The first task was determining the range of mixtures that would be suitable from construction and mechanical stabilization viewpoints. A demonstration field study involved several mixtures, blending techniques and exposure conditions. Favorable TCLP results indicate significant contaminant fixation, and low permeability indicates enhanced physical isolation as well. Recent work includes improving dimensional stability, durability under climatic stresses, and longevity of the matrix under exposure to byproducts of in-situ biological activity. The mechanical, hydraulic and fixation results for various trial mixes and permeants are presented in terms of throughput pore volumes, gradient, overburden load, curing stage, and other stresses or time indexes. The final depositories will be large embankments, such that different mixtures are anticipated as appropriate to variations in the in-situ stress environment. 13 references, 14 figures, 5 tables.

85 (EPRI-AP—5937, pp B.23-B.36) **Low NOx burner retrofit programs on oil- and gas-fired utility boilers.** Giovanni, D.V. Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

Four retrofit case histories are outlined. For each retrofit the following information is given when available: boiler description, fuel and properties, baseline emissions, existing emissions controls, retrofit burner, retrofit driving force, project objectives, emission guarantees, and schedule. A residual oil boiler at the Hawaiian Electric Company, a natural gas and residual oil boiler of the Los Angeles Department of Water and Power, and two natural gas and residual oil boilers of Southern California Edison are the retrofits.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 36, 37, 89, 1767, 1769, 1805, 1812

86 (ALCRC—RRTAC87-3, pp 196-213) **Environmental planning, operating practices and reclamation procedures.** Scott, J.D. (Shell Canada Ltd., Ccalgary, Alta.). 1987. Alberta Environment, Standard Life Centre, 14th Floor, 10405 Jasper Ave., Edmonton, Alta., CAN T5J 3N4; $N/C; MFCANMET/TID, Energy, Mines and Res. CAN, 555 Booth St.,Ottawa, Ont., CAN K1A 0G1; $10 CAN. (CONF-8504337—; MICROLOG—88-04306).

From Gel and saline drilling wastes in Alberta workshop; Edmonton, Canada (23 Apr 1985).

Shell Canada's procedures for handling drilling fluid systems are presented in outline form. Overall design of such systems is conducted so as to minimize waste generation, water use, and environmental disturbance, to maximize drilling fluid reuse, and to ensure environmentally sound disposal and land reclamation techniques. Specific procedures will vary with the type of site, but include site assessment, construction of containment sumps, choosing proper operation of equipment to achieve the aforementioned objectives, proper timing of well completion or abandonment, consideration of the most effective on-lease, subsurface, or off-lease disposal method, and restoration of the well site and associated sumps so that the original state of the site is achieved after site abandonment. Results of operating practice show no major problems to date. 11 figs.

87 (PB—88-235965/XAB) **Natural oil seeps in the Alaskan marine environment. Final report.** Becker, P.R.; Manen, C.A. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). May 1988. 123p. NTIS, PC A06/MF A01.

This report is a synthesis of information on the marine and coastal oil seeps in Alaska, and on the effects of chronic oil pollution on Arctic marine biotic communities and ecological processes. Of 29 oil seepage areas reported along the Alaskan coast, 14 have been confirmed as containing actual oil seeps. Large areas of coastal seepage have been identified in the central Gulf of Alaska and

Arctic regions. When compared to known seepage rates on the California coast, the amount of oil entering the Alaska marine environment from known coastal seeps is probably rather small. Also, the organic enrichment of the benthic communities demonstrated at California seeps might not be as evident at Arctic seeps because of slower rate of oil degradation in the latter. Additional hypotheses on the effects of natural seeps on biological communities and ecosystems are discussed.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 96

0230 Properties

REFER ALSO TO CITATION(S) 69, 70, 96, 856

88 **(DGMK—403) Prospects of quantitative /sup 13/C-NMR-spectroscopy of high boiling oil residues and coal tar pitches.** Dreeskamp, H.; Potempa, T. (Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)). Nov 1987. 54p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

By multi-pulse-sequences the poorly structured /sup 13/C-NMR-spectra of oil- and coal-derived products can be split up in partial spectra for C/sub q/-, CH-, CH/sub 2/- and CH/sub 3/-carbon atoms. To obtain quantitative data the ESCORT-editing extended by an inversegated sequence was used. The addition of one further subexperiment yielded the QUAMUS-technique. Thus an acceptable independence from /sup 1/J/sub CH/ was given. Measurements on 10 authentic samples from other research projects established that quantitative data from each partial spectrum within 10% precision can be obtained within reasonable time (about 10 h). It is shown that the H/C-ratios computed by /sup 13/C-NMR-data only agree with those derived from an elemental analysis within a few percent. (orig.) With 17 figs., 8 tabs., 36 refs.

89 (EPRI-AP—5937, pp 3.69-3.138) **Fuel oil evaluation at the Northside Generating Station.** Davis, K.D. (Jacksonville Electric Authority, FL (USA)). Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

The Technical Services Division Chemical Laboratory has carried out a 30 day test program to determine quality and stability characteristics of fuel at the Northside Generating Station (NSG). The study was performed under the direction of the JEA Fallout Investigation Committee and the Fuel/Fuel Additive Subcommittee. The results of this study are to be used in the investigative efforts with regard to the fallout of combustion products. This report provides a compilation of test data obtained at the NSG from November 13, 1986 to December, 1986. For comparative analysis to determine the validity of the 30 day study, the 1986 fuel shipments results for NSG are included. The principal conclusions are: (1) The fuel oil quality is stable at the Northside Generation Station. Any excursions in particulate emissions at NSG are not likely to be caused by varying fuel characteristics. (2) For the 30 day study, the fuel oil was within JEA Fuels Managements specification requirements for sulfur and asphaltenes. (3) For the year of 1986, the shipments of oil received at NSG were overall within Fuel Managements' specification requirements. (4) The effect of fuel oil shipment receipt on fuel quality during the 30 day study was minimal. 30 figures, 4 tables.

90 (EPRI-AP—5937, pp 3.139-3.174) **Assessment of rapid methods for predicting stability and compatibility of residual fuel oils.** Anderson, R.P. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)). Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—). Contract FC22-83FE60149.

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

The declining quality of residual fuel has become a significant concern to residual fuel oil users in the electric utility industry. This declining quality may be manifested throughout the generating system. This paper is concerned with the specific problems of instability (formation of sediment, changes in viscosity) and incompatibility (formation of sediment on dilution or blending with another fuel) which may adversely affect the fuel receiving, storage, and handling systems. In the previous phase of the project, samples were obtained from utilities to assess rapid tests which appeared to have promise for predicting incompatibility/instability. Results of the predictive tests were compared with results of laboratory baseline tests which were developed for demonstrating instability or incompatibility. Tests which show promise for use in prediction of various aspects of instability include a modified spot test, sediment by hot filtration, sediment by extraction, and the Shell accelerated dry sludge test. As reported earlier by Exxon workers, incompatibility can be predicted by a comparison of the solvent quality (measured by Bureau of Mines Correlation Index) of a fuel oil blend with the solvent quality demand (measured by toluene equivalence). In the current phase of the project, the tests which have shown promise in the earlier phases are being implemented in selected utility laboratories. A dedicated effort is being made to correlate the results of the predictive tests with actual performance of the fuel in the utility environment. 12 references, 12 figures, 6 tables.

91 (EPRI-AP—5937, pp 3.175-3.186) **ASTM activities related to heavy fuel oils.** Greenlee, R.W.; Berg, M.E. (Petrolite Corp. (USA)). Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

This paper reviews activities of the ASTM Committee D.02, the Petroleum Products and Lubricants committee. Standards for heavy fuel oils are described including specifications, burner fuel oils, gas turbine fuel oils, diesel fuel oils, marine fuel oils, and test methods. Work in progress on fuel contaminants, stability and compatibility, aging of heavy fuel oils, sediments, and water-in-fuel emulsions is briefly described.

92 (EPRI-AP—5937, pp B.37-B.45) **Florida Power and Light fuel oil quality improvement story.** Poce, J. (Florida Power and Light (USA)). Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

Recently combustion difficulties have been experienced at Florida Power and Light due to plant equipment plugging caused by fuel oil quality. An analysis of the problems showed that there was extraneous material in the fuel oil. Types of materials isolated from the fuel oil were catalytic fines, rust particles, fibrous materials, resin-like beads, amber beads, and plastic beads. Currently work is being done to determine the source of the extraneous materials in order to develop countermeasures.

0250 Combustion

REFER ALSO TO CITATION(S) 77, 85, 2672

93 (EPRI-AP—5937, pp 3.1-3.16) **Combustion and spray characteristics of residual oil and its emulsions with water.** Yao, J.; Hung, C. (Energy & Mining Research/Service Organization (Taiwan)). Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

An experimental investigation of the effects of emulsification of No. 6 oil with water on the atomization behavior and the flame structure of its burning sprays over a pressurized atomizer is presented. The Rosin-Rammler mean diameter of the spray and the parameters of the following have been studied: flame appearance; temperature profile, amount of O_2, CO_2, CO, NOx, SO_2 in flue gas; the total heat flux of flame. Also the boiler efficiency was measured in a 5 ton/hr boiler. Laser light diffraction particle sizing technique was applied as a diagnostic tool to measure the particle droplet size distribution. With the atomization pressure of 22 kg/cm^2 and the preheating temperature range of 80 to 120°C, the spray of the emulsions with 0% to 25% water content and 0.05% surfactant was studied and the Rosin-Rammler mean diameter was measured. The results show that with the addition of water in the oil, the mean diameter is smaller. The combustion experiments were carried on a semi-water cooled wall furnace equipped with a gun type burner to burn the emulsions with 16 R-type thermocouple in the roof of furnace to measure furnace temperature distribution and with 30 aluminum tube in the bottom of the furnace to remove combustion heat. The excess air was fixed at 5%. The measurements show that emulsion of residual oils results in decrease of flame temperature, total heat flux, flue gas temperature, NOx concentration and increase in percentage of available heat, CO and SO_2 concentration.

94 (EPRI-AP—5937, pp 3.45-3.67) **Full-scale combustion tests using high-asphaltene and low API gravity residual oils.** Molino, N.M. (New England Power Service Co., Westborough, MA (USA)). Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

Today, utilities that can handle or adapt to a wide variety of heavy residual oils may find themselves in a better bargaining position when negotiating oil contracts which could result in substantial savings in fuel costs. The primary objective of the combustion program at NEP is to make the fuel oil specification as non-restrictive as possible in order to achieve the lowest possible busbar cost for electrical energy. Two types of heavy resids that have the potential to reduce the fuel cost are resids high in asphaltenes, sulfur and trace metals; and, low API gravity resids, i.e., with API gravities less than 10. Recognizing these possibilities, NEP decided to extend the emulsion tests at Salem Harbor Station and expand the combustion program to include tests using low API gravity oil in a similar 450 MW boiler at the Brayton Point Station. Performance results are given.

95 (EPRI-AP—5937, pp 3.187-3.221) **Carbon burnout in residual oil fired boilers.** Walsh, P.M.; Sayre, A.N.; Beer, J.M.; Olen, K.R.; Piper, B.F.; Mormile, D.J. (Massachusetts Institute of Technology, Cambridge (USA)). Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

A successful model for unburned carbon emissions must account quantitatively for the unusual, as well as the typical properties of the carbon particles and the gas flow. In an earlier model, a distribution of carbon conversion was introduced to account for variations in particle size, residence time, temperature, and oxygen concentration in a furnace. In a subsequent paper the distribution of coke particle size formed in a residual oil flame was shown to be one of the principal sources of the limitation on carbon burnout. Study of the effects of individual particle and flow characteristics is continued in the present paper, with consideration of a distribution of residence times superimposed on the particle size distribution. A relationship between the size of a spray droplet and its coke residue has also been incorporated in the calculations, making it possible to simulate the influence of fuel oil temperature on unburned carbon emissions. Furnace gas temperature and oxygen concentration are assigned fixed values for the entire flow. The purpose of the model is to provide a method for the correlation of data from a particular unit or type of unit. The model relates unburned carbon in stack particulate to fuel oil asphaltenes, vanadium, viscosity, excess oxygen, furnace temperature, mean residence time, and the minimum residence time of gas and particles in the furnace. Using this type of analysis the results of a limited number of field measurements can be generalized to provide a basis for estimates of the effects of changes in fuel specification, operating procedures, or equipment on the contribution of unburned carbon to particulate matter emissions. Correlations have been obtained for unburned carbon emissions from combustion of both high and low sulfur residual fuel oils. 36 references.

96 (EPRI-AP—5937, pp 3.223-3.242) **EPRI residual oil users guidebook: status report.** Schreiber, H.; Thompson, R.E. Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

The increasing severity of refining process to increase the yield of higher grade products from crudes, together with the uncertainty of the ultimate sources of shipments of residual oil over a period of time, have combined to cause increasing difficulty to resid fired power plant operations. These difficulties affect handling and storage of resids, compatibility, particulate and gaseous emissions, corrosion and erosion of fuel and combustion products related equipment, heat rate, availability, and of course, ultimately, operating economics. In order to provide an information source presenting current knowledge on the subject of using residual oil under these conditions, EPRI is sponsoring the preparation of a Residual Fuel Oil Users' Guidebook addressing the subjects of residual fuel oil fundamentals, and the use of residual fuel oil in utility boilers, utility diesels and combustion turbines. This Guidebook will be in a looseleaf format, and can be updated periodically as sufficient new informational material of use to resid oil firing utilities becomes available. A key item in this Guidebook is a bibliography of published material related to residual fuel oil and its uses, covering the period 1973 to 1985, during which the rapidly worsening trend in residual oil related operating problems began. This bibliography can also be updated periodically. Publication of the initial edition of the Guidebook is planned for June 1988.

97 (EPRI-AP—5937, pp 4.1-4.9) **Group discussions.** Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

The Group Discussion sessions were included in the 1987 Fuel Oil Utilization Workshop as a means to provide the participants with an opportunity to share problems, opportunities, and solutions. Each two-hour discussion group was conducted as an open forum, allowing a free-flow of communication on subjects of relevance to the assembled audience. Brief summaries are presented for the following topics: technology development, operating problems and methods, atomization fundamentals and applications, and fuel supply.

98 (EPRI-AP—5937, pp B.1-B.21) **Fundamentals of atomization with application to heavy fuel atomizer design.** Jones, R.V. Jul 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88015232/JAW. (CONF-8710362—).

From Fuel oil utilization workshop; Boston, MA, USA (21 Oct 1987).

This paper outlines fundamental atomization concepts (jet breakup, flat sheets, drop interaction with air, drop size distribution, and spray profile and pattern); describes pressure operated simplex nozzles, twin-fluid atomizers, and spill-return atomizers; and discusses application of the fundamentals to design. It is concluded that the application of these fundamentals to atomizer design will lead to new and radically different atomizer designs which will produce finer sprays with fewer large drops without an increase in stomizing steam consumption.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 64, 66, 1768

99 **(PB—88-247556/XAB) Field-data acquisition for tight-gas-sands research. Annual report, May 1987-April 1988.** Peterson, R.E. (CER Corp., Las Vegas, NV (USA)). Aug 1988. 49p. NTIS, PC A03/MF A01.

See also PB—88-101100.

This report presents the major accomplishments during the 12-month period included: coordination and implementation of a major field experiment in northwest Colorado; acquisition of co-op well data from wells operated by Kerr-McGee Corporation and Amoco Production Company in the East Texas area; research services and data acquired through 15 subcontracts; and publication of two issues of In Focus - Tight Gas Sands.

100 **(PB—88-247564/XAB) Support operations contractor for the Staged Field Experiment Nos. 1 and 2. Final report, July 1, 1986-March 31, 1988.** Peterson, R.E. (CER Corp., Las Vegas, NV (USA)). Jul 1988. 179p. NTIS, PC A09/MF A01.

This report summarizes the technical and administrative work performed by CER Corporation in supporting GRI's Staged Field Experiment (SFE) Nos. 1 and 2. The objective of the SFE Program was to acquire data and perform research experiments in a relatively unrestricted environment. With GRI-controlled wells, more-intensive open- and cased-hole data-acquisition programs could be implemented and completion programs structured around the data analyses. In support of the overall, CER contributed significantly through performance of the following activities: preparation of operations-oriented reports; coordination and supervision of open-hole data acquisition programs; on-site administration of costs and activities associated with the field work; home-office support in contracting, procurement, and accounting of the costs associated with drilling, completing, and producing the wells; and preparation and distribution of SFE reports to individuals in research and industry.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 71

101 **(DGMK—383) Investigation of the gas-tight threaded joints for natural gas production. Final report.** Klein, R.; Koithan, T.; Sager, J.; Sawitzki, M.; Stoffels, P. (Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Mar 1988. 102p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

Gas-tight threaded joints are used in linings and risers of the natural gas industry, although there are still some problems concerning their practical application. The authors investigated the influences governing the handling of gas-tight threaded joints in transport, jointing and field-testing; on this basis, they present recommendations concerning the assembly of gas-tight pipelines and the improvement of pipeline safety. An extended method of calculation for determining the optimum screening momentum and a novel method of analysis for determining stress distributions in the thread and joint region are presented. Gas permeability testing of threaded joints screwed up in situ is hampered by the temporary sealing effect of thread grease. Improved greasing techniques to prevent this are investigated, and surface treatment techniques using ion implantation are investigated which are to prevent corrosion in the thread and joint region. (orig.) With 30 figs., 12 tabs.

102 **(DOE/EIA—M034) Model methodology and data description of the Production of Onshore Lower 48 Oil and Gas model.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Sep 1988. 85p. NTIS, PC A05/MF A01 - GPO. Order Number DE89002113/JAW.

This report documents the methodology and data used in the Production of Onshore Lower 48 Oil and Gas (PROLOG) model. The model forecasts annual oil and natural gas production on a regional basis. Natural gas is modeled by gas category, generally conforming to categories defined by the Natural Gas Policy Act (NGPA) of 1978, as well as a category representing gas priced by way of a spot market (referred to as "spot" gas). A linear program is used to select developmental drilling activities for conventional oil and gas and exploratory drilling activities for deep gas on the basis of their economic merit, subject to constraints on available rotary rigs and constraints based on historical drilling patterns. Using exogenously specified price paths for oil and gas, net present values are computed for fixed amounts of drilling activity for oil and gas development and deep gas exploration in each of six onshore regions. Through maximizing total net present value, the linear program provides forecasts of drilling activities, reserve additions, and production. Oil and shallow gas exploratory drilling activities are forecast on the basis of econometrically derived equations, which are dependent on specified price paths for the two fuels. 10 refs., 3 figs., 10 tabs.

103 (ESA-SP—280, pp 243-246) **Underwater robotics in the service of oil field exploitation: the Running and Interconnecting Tool (RIT) in the East Frigg field (North Sea).** Chereau, J. Mar 1988. (In French). NTIS, PC A15/MF A01. (ETN—88-92782; CONF-8711239—).

From Colloquium on space and sea; Marseille, France (24 Nov 1987).

The Running and Interconnecting Tool (RIT) was developed for the installation of modules of an underwater gas production station without using divers. The RIT consists of a module maintenance structure; a crane for maintenance of the multiconnectors and protective coverings; a video system; an electrohydraulic umbilical line; a control cabin and hydraulics cabin on the surface; and an electrohydraulic control system. The RIT is designed to operate during the entire 14 yr life of the field, for 15 day periods 2 or 3 times a year.

0304 Products And By-products

104 (CGA—8705, pp 107-112) **A liquefaction, storage & vaporization plant.** Plante, G. (Gaz Metropolitain, Inc.). 1987. (In French). Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ont., Canada M3B 2R3; $8.00 CAN. (CONF-8705317—; CE—01895).

From 6. annual gas measurement school; Quebec City, Canada (26 May 1987).

This paper describes a plant in Montreal which has the capability of liquefying 283,000 m/sup 3/ of natural gas per day, vaporizing 6.8 million m/sup 3/ of gas per day, and storing 600,000 bbl of liquid natural gas in two tanks. The liquefaction process, using an auto-refrigeration cycle system, is described. Operating details of the vaporization plant, storage system, instrumentation and controls, and auxiliary equipment are also given.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 54, 82, 117

105 **(DOE/EIA—0130(88/08)) Natural gas monthly, August 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 31 Oct 1988. 139p. NTIS, PC A07/MF A01 - GPO. Order Number DE89002405/JAW.

Important developments for the natural gas industry during 1987 included consumption increased by 5.6 percent, reversing a 9.6 percent decline over the previous 2 years. Deliveries to consumers increased by 5.7 percent in the industrial sector, 4.1 percent in the

commercial sector, and 9.3 percent in the electric utility sector; deliveries to gas consumers for the account of others increased markedly over 1986 levels, particularly in the industrial sector where the rise was more than 37 percent; and the average industrial and commercial consumer used more natural gas in 1987, while the average residential consumer used less. 6 figs., 33 tabs.

106 (DOE/EIA—0131(87)/1) **Natural gas annual 1987: Volume 1.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 25 Oct 1988. 229p. NTIS, PC A11/MF A01 - GPO. Order Number DE89002416/JAW.

A highly competitive pricing environment continued to characterize the natural gas industry in 1987 as end-users and local distributors sought lower prices supplies, and new transportation arrangements continued to alter traditional methods of supply acquisition. The industry reversed a 2-year decline with consumption rising in all major market sectors, and domestic and imported supplies increasing to meet the greater demand. Natural gas prices fell from 1986 levels despite stable or increasing prices for most competing fuels. The "transportation" market for natural gas continued to expand as indicated by the dramatic increase in deliveries to natural gas consumers for the account of others. This expansion was encouraged by a number of regulatory developments designed to increase access to transportation services. Important developments for the natural gas industry during 1987 included consumption increased by 5.6 percent reversing a 9.6 percent decline over the previous 2 years. Deliveries to consumers increased by 5.7 percent in the industrial sector, 4.1 percent in the commercial sector, and 9.3 percent in the electric utility sector; deliveries to gas consumers for the account of others increased markedly over 1986 levels, particularly in the industrial sector where the rise was more than 37 percent; and the average industrial and commercial consumer used more natural gas in 1987 while the average residential consumer used less. 21 figs., 98 tabs.

107 (EPRI-P—5993, pp 2.1-2.13) **Natural gas issues for electric utility analysis: 1987 EPRI fuel supply issues.** Huntington, H.G.; Platt, J. (Stanford Univ., CA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

The seventh annual EPRI Fuel Supply Seminar was held in Baltimore, Maryland, October 6-8, 1987. The topics spanned natural gas issues, utilities' approaches to strategic fuel planning, and the changing coal transportation market. The first day was devoted entirely to natural gas issues. The morning session - New Directions in Natural Gas - included three presentation on development costs, emerging questions for analysis and federal regulatory policies. The afternoon session - Key Natural Gas Issues Panel - included prepared remarks and discussion by four speakers with expertise across (a) economics of domestic supply, (b) interfuel pricing and demand, (c) Federal regulatory policy and gas transmission and (d) gas acquisition strategies of large purchasers. Dr. Huntington organized the sessions and acted as chairman and moderator. This paper provides a summary and interpretation of the main points raised during the meeting that, in the authors' view, are of greatest interest to the electric utility fuel planning and procurement community. The paper begins with an overview of the highlights, followed by a more extended list and discussion of the main points.

108 (EPRI-P—5993, pp 3.1-3.17) **Costs of development of U.S. gas potential.** Kent, H.C. (Institute for Energy Resources Studies, Golden, CO (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

Two fundamental questions face natural gas users. (1) What is the future supply of natural gas? Is there an adequate resource? Will it be available when needed? (2) If supply is adequate, will the cost be competitive with other fuels? This paper describes the efforts of various governmental and private groups to maintain a data base capable of answering these questions. The paper examines some elements of the data base and how they have been derived, then summarizes some of the results to date. The results of the study are useful at this stage primarily as a major data base of resource information and for comparing costs from one area to another. Future gas supplies are not merely an economic concept in which price is the only determinant of supply, nor is it appropriate to blindly extrapolate past relationships between drilling and reserve additions. The resource exists at different places under different conditions and the costs and results of exploration can vary widely. It is true that, in general, the largest fields in any exploratory play are found early and the smaller fields are found later in the cycle. But there are many irregularities and the results of exploratory drilling are not systematic or predictable. Factors related to demand, competition, price, infrastructure (pipelines and support services) and experience all contribute to determine gas supply. It appears from this work, however, that it can be shown that a considerable supply of gas exists which can be brought into the market at a realistic cost, given consistent demand and reasonable stability of price. 18 figures.

109 (EPRI-P—5993, pp 4.1-4.14) **Towards an integrated natural gas market; new directions for analysis.** Huntington, H.G. (Stanford Univ., CA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

The modeling boom of the 1970s was driven by a desire for precision in projections. As the authors have discovered in recent years, precise information may not always be valuable. The 1986 oil price collapse and the wholesale restructuring of the electricity and natural gas industries are causing them to junk previous forecasts and analyses and also to rethink the approach for evaluating energy markets. This paper offers some preliminary thoughts on the likely direction of these efforts to recast analysis in the natural gas area. The paper discusses: uses of modeling and analysis; anticipating market changes; emerging integration in the market; some scenarios; gas resources and supply; gas consumption and prices; North American gas trade; increased gas demand by electric utilities; and conclusions.

110 (EPRI-P—5993, pp 5.1-5.6) **Federal gas regulatory policies.** O'Neill, R.P. (Federal Energy Regulatory Commission, Washington, DC (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

The regulatory environment that electric utility supply planners face in the natural gas industry is influential to decision making. In the author's opinion, a wider view of the history of oil and gas markets is the foundation for understanding the Federal Energy Regulatory Commission (FERC) role now and the outlook for the future. The author discusses forecasting prices and interfuel competition, gas markets and contracts, the role of FERC in natural gas commodity markets, and the role of FERC in transportation.

111 (EPRI-P—5993, pp 6.1-6.9) **US natural gas supply issues.** Cheung, P.D. (ARCO Oil and Gas Co., Dallas, TX (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

When considering the US natural gas picture from a producer standpoint, two extreme views are seen. Some producers stress that gas may soon be in very short supply. On the other hand, the American Gas Association says that gas will be available in large quantities at competitive prices, indefinitely. The author remarks on this topic reflect his own views and may not be those of Arco Oil and Gas Company. The author's theme is life is simple if you have no choice, but we know that the gas industry is becoming more complex for both buyers and sellers. Three areas are discussed. First, some general observations about the current natural gas market place, from a producer standpoint - without griping. Second, the medium to long-term supply outlook, recognizing the resource base. Finally, a discussion of the need for long-term contracts as a risk-sharing device for procuring natural gas supplies.

The latter may be especially relevant for combined-cycle power generators.

112 (EPRI-P—5993, pp 7.1-7.12) **Outlook for natural gas supply, demand and price.** Jensen, J.T. (Jensen Associates, Inc., Boston, MA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

Natural gas demand was down in 1986. One major reason was the collapse of oil prices which set off price competition from residual fuel oil in dual-fired boiler installations. Data are presented to illustrate and explain regional differences in the loss of gas demand. The paper also analyzes the complexity of the natural gas supply/demand curve. Effects on the market from wellhead price controls, inflexible contracts, natural gas reserve additions, and the allocation of costs between oil and gas are also discussed. The paper concludes that the critical element to watch will be the effect on gas drilling activity of the natural gas price increase which the author expects to see as the gas surplus ends.

113 (EPRI-P—5993, pp 9.1-9.10) **State of the gas spot market: new North American trading patterns.** Schlesinger, B. (Benjamin Schlesinger & Associates, Bethesda, MD (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

This paper discusses natural gas supplies and pipeline capacity, growth of gas spot trading, the faster response of spot prices to rapidly changing market conditions, FERC involvement to resolve take-or-pay contracts, gas marketers as a new segment of the gas industry, longer-term contracting, competition among interstate pipelines, and the gas futures market. An update on FERC Order 500-B is given, summarizing the changes this made to the interim rule on open-access transportation.

114 (INIS-mf—11815, pp 336-354) **Tasks and structure of the gas industry.** Ederer, F. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The paper points out the part played by the energy source gas in energy supply, and analyses the boundary data for the gas industry: gas production, gas use, gas prices. This is followed by a description of the tasks and structure of the gas industry. Finally the paper says that, while not all energy problems can be solved by giving clear preference to gas, gas will help to achieve some basic goals of energy policy, for instance international, environmental, and social compatibility. Economic efficiency will, however, be subject to the respective price trends for gases and their substitutes. (orig./HSCH).

115 **(PB—88-235494/XAB) Gas Research Institute 1989-1993 research and devlopment plan and 1989 research and development program. Executive Summary.** (Gas Research Inst., Chicago, IL (USA)). Jun 1988. 25p. (GRI—88/0190.2). NTIS, PC A03/MF A01.

See also PB—88-235486.

The executive summary of the GRI 1989-1993 R&D Plan and the 1989 R&D Program provides an overview of the strategic objectives, the 1989-1993 program budget and the major emphasis of the 1989 R&D program. An appendix provides the planned project area contract R&D obligations budgets for Supply Options, Gas Operations, End Use and Crosscutting Research.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 86

116 **(PB—88-245857/XAB) Gas range/oven emissions impact analysis: appendix. Final report, July 1985-December 1987.** Tikalsky, S.; Reisdorf, K.; Flickinger, J.; Totzke, D.; Haywood, J. (Dames and Moore, Madison, WI (USA)). Dec 1987. 123p. (D/M—7683-062). NTIS, PC A06/MF A01.

See also PB—88-232756; Portions of this document are not fully legible.

Ten older homes in Wisconsin were selected to participate in the pilot project to determine if field measurements of NO_2 and CO on gas ranges vary significantly from those reported in the literature, and if use of both vented and unvented gas appliances can be apportioned to determine separate impacts. Continuous NO_2 and CO measurements were taken in several locations within each home during two measurement periods. Homeowners also kept detailed diaries of gas-appliance use. The results indicate that the gas oven was frequently implicated in the small group of case study homes as a source of peak hourly average NO_2 concentrations; NO_2 emission rates were as much as a factor of two greater than those previously reported. The study also found that routine service adjustments on the ten-range set resulted in statistically significant decreases in CO and NO_2 emission rates following servicing. This finding implies that some servicing of the gas range may be desirable and have an impact on indoor levels of NO_2 and CO.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 99

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 107, 110, 113, 735

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 101, 712, 1331, 1448

117 **(PB—88-245766/XAB) R and D planning implications of shifts in gas-delivery patterns. Final report, November 1987-July 1988.** Joyce, T.J. (Joyce (T.) Associates, Inc., Fairfax, VA (USA)). Jul 1988. 83p. NTIS, PC A05/MF A01.

A data base that includes the information on natural gas sales and transportation services provided by interstate pipelines to consumers in natural-gas-producing states was compiled. The data were analyzed to identify main-line industrial sales and volumes transported to industrial end-users. The extent to which intrastate gas might displace interstate sales was then estimated on the basis of availability of in-state gas production; the capability of the intrastate pipeline network to deliver gas to end users; and the regulatory attitude toward encouraging in-state gas sales.

0340 Combustion

REFER ALSO TO CITATION(S) 85, 116, 854, 2672

04 OIL SHALES AND TAR SANDS

0401 Reserves And Exploration

118 **(NBNRE—1988) Assessment of potential sites of recoverable oil shale in New Brunswick.** Green, M. (New Brunswick Dept. of Natural Resources and Energy, Fredericton (Canada). Minerals and Energy Div.). 1988. 73p. (MICROLOG—88-03953). New Brunswick Dept. of Natural Resources and Energy, P.O. Box 6000, Fredericton, N.B., Canada E3B 5H1; $7.80 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An assessment of organic matter and available calcium content in New Brunswick Albert Formation lacustrine oil shales was initiated following recent tests which demonstrated that calcium-bearing oil shales are an effective sulfur sorbent when cocombusted with high-sulfur coal. In 3 areas there are sufficient data to make guarded estimates of resource potential. Four drill holes in the Rosevale area intersect a 14 m thick shale bed with a strike length of 990 m. The bed has an average shale oil yield of 102 l/tonne and contains an in-place reserve of over 2.5 million barrels to a depth of 100 m. The shale has a calcium content of 11.4 wt% and would provide about 460,000 tonnes of calcium. Two drill holes in the Dover area cut an oil shale bed 11 m in thickness with an estimated strike length of 2,350 m. The bed has an average shale oil yield of 98 l/tonne and to a depth of 100 m contains an in-situ resource of 8.4 million bbl. Four analyses for Ca0 indicate a calcium content of 12 wt%. The calcium is mainly present in calcite and would thus be available for sulfur gas neutralization. 28 drill holes at Albert Mines intersect an oil shale bed with a strike length of 2,050 m at 19.8 m average thickness. A reassessment of the geology shows that the oil shale is repeated by two faults, effectively doubling the tonnage of high-grade shale available at the surface. The bed has an average oil content of 95 l/tonne and an in-place reserve of 5.8 million barrels to a depth of 100 m. Five analyses indicate that the shale may contain an average calcium content of 13.9 wt% which would provide about 800,000 tonnes of calcium to a depth of 100 m. 34 refs., 8 figs., 42 tabs.

0402 Site Geology And Hydrology

119 **A study of the reduction of brine permeability in Berea sandstone with the aluminum citrate process.** Parmeswar, R.; Willhite, G.P. (Kraft Inc., Glenview, IL (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 3: No. 3, 959-966(Aug 1988).

A systematic study of permeability modification of Berea sandstone by the injection of alternate slugs of polymer and aluminum citrate is described. The research included brine permeabilities from 10 to 300 md. Results of treatments with Pusher 700/sup TM/ showed that permeability reduction was limited to the front end of the core (0 to 4 in. [0 to 10 cm]). The effective mobility of the treated region was so low that in-depth treatment of the remainder of the core was prevented. The amount and distribution of permeability reduction is related to both polymer and aluminum retention. The retention of aluminum was found to be a nonequilibrium process, varying with the flow rate and thus residence time in the core. Aluminum was retained in large quantities in Berea core in the absence of polymer. Changing the treatment sequence to aluminum citrate/brine/polymer/brine yielded in-depth treatment of cores 12 to 48 in. [30 to 121 cm] in length. Both magnitude and persistence of permeability reduction were comparable to or better than those obtained with the combination process. Permeability increased with distance from the core inlet in most runs. This is believed to be caused by nonuniform distribution of retained aluminum.

120 **Effect of capillary number on the microstructure of residual oil in strongly water-wet sandstones.** Chatzis, I.; Kuntamukkula, M.S.; Morrow, N.R. (New Mexico Inst. of Mining and Technology (US)). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 3: No. 3, 902-912(Aug 1988).

Changes that occur with increase in capillary number in the detailed structure of residual oil trapped in water-wet sandstone core samples have been investigated. The technique of using a nonwetting phase that can be solidified and separated from the porous medium has been applied with styrene monomer as the nonwetting phase and 2% CaCl/sub 2/ brine as the wetting phase. The size distributions of residual oil blobs, obtained under various flow conditions, were measured by both image analysis and Coulter counter techniques. Specific features of blob shapes and dimensions were checked by optical and electron microscopy. The changes in size distribution and shapes of blobs provide insight into the mechanisms of trapping and mobilization of residual oil.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 119

05 NUCLEAR FUELS

121 **(PB—88-868039/XAB) Sol-gel processes. January 1970-September 1988 (Citations from the NTIS database). Report for January 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 83p. NTIS PC N01/MF N01.

Supersedes PB—87-868154.

This bibliography contains citations concerning the development and utilization of sol-gel processes and techniques. Topics include antireflective coatings, studies of sol-gel transitions, sol-gel synthesis and polymerization, sol-gel derived thin films and glasses, and sol-gel production of microspheres. Applications in nuclear waste management, nuclear fuel manufacturing, glass optical waveguide development, and solar energy collection are presented. (This updated bibliography contains 140 citations, 28 of which are new entries to the previous edition.)

0504 Feed Processing

122 **(ANL—88-29) Laboratory-scale study of electrolytic reduction of uranium oxides.** Poa, D.S.; Burris, L.; Steunenberg, R.K.; Tomczuk, Z. (Argonne National Lab., IL (USA)). Jun 1988. Contract W-31109-ENG-38. 44p. NTIS, PC A03/MF A01. Order Number DE89001031/JAW.

An exploratory study was undertaken to investigate potential improvements in the electrolytic reduction of uranium oxide to the metal. Potential advantages of the electrolytic procedure over existing chemical reduction processes are (1) lower operating temperatures, which alleviate materials problems and heating requirements, (2) removal of most impurities, and (3) elimination of solid by-product wastes. The results showed that UO_2 can be reduced electrolytically in a molten $LiF-KF-NaF-CaF_2-UF_4$ electrolyte at 975{degree}C, and at current densities from 500 to 900 mA/cm^2. The metallic uranium product was collected as a solid deposit on a molybdenum or uranium cathode rod. 14 refs., 20 figs., 3 tabs.

123 **(INIS-BR—1277) Fines recovery of the phosphoro-uraniferous ores from Itataia-CE.** Furtado, J.R.V. (Minas Gerais Univ., Belo Horizonte (Brazil)). 1985. 130p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704520/JAW.

Cyclone desliming previous to flotation is one of the determining factors of the concentration performance of phosfate ores. The physical beneficiation of the phosphoro uraniferous ore of Itataia, carried out in the pilot plant, rejects approximately 10,5% P/sub 2/O/sub 5/ and 14% U/sub 3/O/sub 8/ contained as "slimes". The present investigation was to develop a process to recover the fines through the tecniques of flotation and Seletive Floculation. The low P/sub 2/O/sub 5/ content and extremely small size of the "slimes", led to a low efficiency in the operation of either flotation. The introduction of a Second disliming step swhed promising results. It is work mentioning that the ore presents siliceous-carbonatic gangue and that the direct flotation of phosphates rejects only the silicate portion. Direct flotation followed by reverse flotation of

carbonates led to phosphate concentrates containing 28% P/sub 2/ O/sub 5/ with recoveries of 60%. The results obtained indicate that the fines treatment may lead to increase of 4,5% in overall recovery without decreasing the grade of the final concentrate. (C.D.G.).

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 584, 590, 591, 592, 593, 595, 597, 599, 622, 2331, 2332, 2341

124 **(DPST—88-249) A feasibility study to determine blending characteristics and extrudability of aluminum and silicon carbide coated microspheres.** Peacock, H.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 25 Jan 1988. Contract AC09-76SR00001. 20p. NTIS, PC A03/MF A01. Order Number DE89001424/JAW.

This report discusses the results from the extrudability studies done to determine if microspheres can be used to manufacture tubular fuel elements. Tests were carried out using both the small-scale extrusion press in the Fabrication Laboratory and the production extrusion press in the plant. 2 refs., 11 figs., 1 tab.

125 **(PNL-SA—15798) Waste acid detoxification and reclamation.** Brouns, T.M.; Stewart, T.L. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 17p. (CONF-880839—7). NTIS, PC A03/MF A01. Order Number DE89001515/JAW.

From Annual DOE low-level waste management conference; Denver, CO, USA (30 Aug 1988).

Economically feasible processes that reduce the volume, quantity, and toxicity of metal-bearing waste acids by reclaiming, reusing, and recycling spent acids and metal salts are being developed and demonstrated. The acids used in the demonstrations are generated during metal-finishing operations used in nuclear fuel fabrication; HF-HNO_3, HNO_3, and HNO_3-H_2SO_4 wastes result from Zr etching, Cu stripping, and chemical milling of U. At discharge, wastes contain high concentrations of acid and one major metal impurity. The waste minimization process used to reclaim acid from these three streams incorporates three processes for acid regeneration and reclamation. Both etch and strip solutions are reclaimed for recycle by precipitating major metal impurities and concurrently regenerating acid; Zr is removed as Na_2ZrF_6 and Cu is removed as CuC_2O_4. Based on large bench-scale test results (95-L batches), the volume of etch solution discharged as waste can be reduced by 98%. Similarly, the volume of strip solution discharged as waste can be reduced by 90%. Payback periods of 0.6 and 1.3 years, respectively, have been estimated based on reduced storage, treatment, and disposal costs for these two waste acid streams. The chemical milling solution and any residual waste acid from etching and stripping operations can be reclaimed using distillation with H_2SO_4. 8 refs., 8 figs., 1 tab.

126 **Method for removal of plutonium impurity from americium oxides and fluorides.** FitzPatrick, J.R.; Dunn, J.G.; Avens, L.R. US Patent Application 6-014,324. 13 Feb 1987. 8p. Contract W-7405-ENG-36. NTIS, PC A02/MF A01.

Method for removal of plutonium impurity from americium oxides and fluorides. AmF_4 is not further oxidized to AmF_6 by the application of O_2F at room temperature thereto, while plutonium compounds present in the americium sample are fluorinated to volatile PuF_6, which can readily be separated therefrom, leaving the purified americium oxides and/or fluorides as the solid tetrafluoride thereof.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 290

127 (INIS-mf—11815, pp 179-205) **Reprocessing of irradiated nuclear fuels - a partial step in nuclear waste disposal.** Baumgaertel, G.; Kroebel, R. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The contribution is concerned with the following subjects: nuclear fuel cycle of light-water-moderated reactors; aims of fuel reprocessing; reprocessing - fundamentals - technical sequence; existing fuel reprocessing plants - in the Federal Republic of Germany - abroad; planned fuel reprocessing plants; experience gathered with fuel reprocessing. The PUREX process has proved worldwide to be the best reprocessing technique so far for irradiated nuclear fuels. (HSCH).

128 **(JAERI-M—88-127) Modified density equation for aqueous solutions with plutonium(IV), uranium(VI) and nitric acid.** Sakurai, Satoshi; Tachimori, Shoichi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 41p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755227/JAW.

In order to calculate criticality parameters for the nuclear fuel solution systems, number densities of nuclides are needed and generally calculated from empirical density equations. For the system of Pu(IV), U(VI), nitric acid and water, two density equations had been reported. The accuracy of them, however, had not been examined thoroughly for the wide range of temperature and concentration of solutes. The modified density equation for the system was derived from regression analysis for 161 sets of reported data adding 60 sets of recent Cauchetier's data. This equation gave more reliable densities in the wide range of temperature and concentration compared with other reported equations.

129 **(LA-UR—88-3250) The use of Octyl(phenyl)-N,N,-Diisobutylcarbamoylmethylphosphine oxide to decontaminate hydrochloric acid waste streams.** Palmer, M.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 17p. (CONF-8810174—4). NTIS, PC A03/MF A01. Order Number DE89000338/JAW.

From Plutonium/uranium recovery operations conference; Idaho Falls, ID, USA (4 Oct 1988).

Use of the TRUEX (transuranic extraction) process to decontaminate hydrochloric acid waste streams is a new area of study at the Los Alamos National Laboratory (LANL) Plutonium Facility. TRUEX involves using the extractant Octy(phenyl)-N,N- Diisobutylcarbamoylmethylphosphine Oxide (CMPO) in a diluent, normally tetrachloroethylene (TCE), to remove plutonium and americium from a variety of acidic chloride waste streams. We should be able to discard the raffinate from this process without further processing at the Plutonium Facility, and the plutonium and americium will be in a small, easily handled form. Before attempting full production runs, we performed cold-contact studies and experimental contact work on plutonium- and americium-containing solutions. After these attempts were successful, we tried a pilot run on a large volume of solution from a chloride waste stream. TRUEX, with further work, will hopefully produce a viable product for use at LANL. 1 ref., 5 figs., 12 tabs.

130 **(PNL—5109-106) Characterization of spent fuel approved testing material: ATM-106.** Guenther, R.J.; Blahnik, D.E.; Campbell, T.K.; Jenquin, U.P.; Mendel, J.E.; Thornhill, C.K. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 323p. NTIS, PC A14/MF A01. Order Number DE89002112/JAW.

The characterization data obtained to date are described for Approved Testing Material (ATM)-106 spent fuel from Assembly BT03 of pressurized-water reactor Calvert Cliffs No. 1. This report is one in a series being prepared by the Materials Characterization Center at Pacific Northwest Laboratory on spent fuel ATMs. The ATMs are receiving extensive examinations to provide a source of well- characterized spent fuel for testing in the US Department of Energy Office of Civilian Radioactive Waste Management (OCWRM) program. ATM-106 consists of 20 full-length irradiated fuel rods with rod-average burnups of about 3700 GJ/kgM (43 MWd/kgM) and expected fission gas release of {approximately}10%. Characterization data include (1) as-fabricated fuel design,

irradiation history, and subsequent storage and handling; (2) isotopic gamma scans; (3) fission gas analyses; (4) ceramography of the fuel and metallography of the cladding; (5) calculated nuclide inventories and radioactivities in the fuel and cladding; and (6) radiochemical analyses of the fuel and cladding. Additional analyses of the fuel rod are being conducted and will be included in planned revisions of this report. 12 refs., 110 figs., 81 tabs.

131 **Recovery of mercury from acid waste residues.** Greenhalgh, W.O. US Patent Application 6-019,834. 27 Feb 1987. 12p. Contract AC06-76FF02170. NTIS, PC A03/MF A01.

Mercury can be recovered from nitric acid-containing fluids by reacting the fluid with aluminum metal to produce mercury metal, and thence quenching the reactivity of the nitric acid prior to nitration of the mercury metal. 1 fig.

132 **(ORNL/tr—88/25) Development and study on an electroreduction mixer-settler for separation of plutonium during reprocessing of nuclear fuels.** Schmieder, H. (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. Translated from French Microfilm of thesis presented to the Grenoble National Polytechnical Institute September 1984. 115p. NTIS, PC A06/MF A01. Order Number DE89001721/JAW.

The history of reprocessing nuclear fuels began in the United States in the mid 1940s with the production of plutonium by precipitation according to the well-known bismuth phosphate process. Following that, other extraction methods, particularly by aqueous means, were developed that finally resulted in the Purex process that is used today worldwide. The largest facility in service reprocessing light water reactor fuel is at La Hague in France. This method is based on an extraction by tributyl phosphate (TBP) from nitric solutions. By diluting the TBP with approximately 30% volume of kerosene (essential component n-dodecane), a sufficiently great density difference is reached between the organic and aqueous media to obtain good separation of the phases in the extractors. For this separation, mixer-settlers, pulsed columns or centrifugal extractors can be used. Our research treats the use of mixer-settlers. 61 refs., 34 figs., 13 tabs.

0509 Transport And Storage

133 **(CONF-880631—53) Testing TRANSCOM: US Department of Energy's Radmat tracking system.** Carlson, R.D.; Koehl, E.R.; Harmon, L.H.; Habib, E.J.; Mignone, T.A.; Dutt, S. (Argonne National Lab., IL (USA); USDOE, Washington, DC; Systems Research and Applications Corp., Arlington, VA (USA)). 1988. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01. Order Number DE89000521/JAW.

From 29. annual meeting of the Institute of Nuclear Materials Management; Las Vegas, NV, USA (26 Jun 1988).

A transportation tracking system has been developed by the Department of Energy (DOE) in response to three institutional concerns about shipments of large quantities of radioactive materials: routing, prenotification, and emergency response. This tracking system consists of a location system, a communication system with the carrier, and an information management system which appropriately distributes shipment information to DOE headquarters, field officers, and key state officials. The DOE prototype system developed for this purpose is called TRANSCOM. This paper presents some of all tests that have been performed to demonstrate that LORAN-C is acceptable as a location system for TRANSCOM, and that satellite communications techniques can provide timely results regarding location and communication with carrier vehicles. Three separate tracking tests have been performed to date: 3177 location data points were recorded during a cross-country test from Savannah River, SC to Idaho Falls, ID via Albuquerque, NM; 802 data points were recorded along the Union Pacific Railroad from Omaha, NE to North Platte, NE; 4540 location data points, as well as 2636 satellite-transmitted locations and messages, were recorded on a trip from San Diego, CA; through Albuquerque, NM; Cheyenne, WY; Idaho Falls, ID; and back through Cheyenne to Chicago, IL. 3 refs., 11 figs., 1 tab.

134 **(SAND—88-2760C) Overview of effects of burnup credit on cask design.** Allen, G.C. (Sandia National Labs., Albuquerque, NM (USA)). 2 Nov 1988. Contract AC04-76DP00789. 12p. (CONF-881169—2; TTC—0851). NTIS, PC A03/MF A01. Order Number TI89001667/JAW.

From American Nuclear Society winter meeting; Washington, DC, USA (1 Nov 1988).

A number of opportunities exist to increase the productivity of the next generation of spent fuel shipping casks. One of the opportunities being evaluated by Sandia National Laboratories (SNL) under the sponsorship of the Department of Energy's (DOE's) Cask System Development Program at Idaho is the implementation of burnup credit in the design of spent fuel casks. Burnup credit is defined as accounting for the effects of fuel burnup in the criticality safety analysis of a cask. Burnup is fissile nuclide reduction and fission and activation product buildup, that result in reduced reactivity of fuel after it has been used for producing power in a nuclear reactor. An important step in implementing burnup credit is to establish an understanding as to how burnup credit affects cask design. The purpose of this paper is to provide an overview of the effects of burnup credit on spent fuel cask design. This will be accomplished by addressing the following questions: What functions does a cask perform? How does burnup credit potentially affect a cask? How does burnup credit affect basket design? What design or functional requirements are likely to be affected by burnup credit? 1 fig., 4 tabs.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 158, 160, 281

0520 Waste Management

REFER ALSO TO CITATION(S) 286, 287, 604, 650, 1228, 1229, 1230, 1231, 1232, 1745, 1820

135 **(AERE-M—3604) Source term measurements on vitrified HLW. Progress to December 1985.** Hough, A.; Marples, J.A.C. (UKAEA Harwell Lab. Chemistry Div.). Jun 1988. 17p. (ILWRP—86/P22). H.M. Stationery Office, London, price Pound 4.00.

The rate of release of radioelements from a repository for vitrified high-level waste cannot be greater than the product of the water flow rate through the repository and the equilibrium concentration of the radioelements in the water. This equilibrium concentration has been measured for Tc-99, Np-237, Pu-239/240 and Am-241 under redox and pH conditions that are likely to occur in a repository in hard rock or clay and in the presence of possible overpack and backfill materials.

136 **(CONF-870323—8) Treatment of radioactive wastewaters by chemical precipitation and ion exchange.** Robinson, S.M.; Begovich, J.M.; Brown, C.H. Jr.; Campbell, D.O.; Collins, E.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01. Order Number DE89001933/JAW.

From American Institute of Chemical Engineers spring national meeting; Houston, TX, USA (29 Mar 1987).

Precipitation and ion exchange methods are being developed at Oak Ridge National Laboratory to decontaminate wastewaters containing small amounts of ^{90}Sr and ^{137}Cs while minimizing waste generation. Distribution coefficients have been determined for strontium and cesium as functions of Ca, Na, and Mg concentrations from bench- and pilot-scale data for ion exchange resins and zeolites using actual wastewaters. Models have been used to estimate the total amount of waste that would be generated at full-scale operation. Based on these data, four process flowsheets are being tested at full-scale. 14 refs., 8 figs., 7 tabs.

137 (CONF-870859—Pt.1, pp 1-16) **INEL low-level waste management: a step in the right direction.** Blanchfield, L. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Idaho National Engineering Laboratory (INEL) has recently developed a strategy for the management of its low-level radioactive waste (LLW) over the next ten to twenty years. The strategy addresses management of solid LLW and, to a lesser extent, liquid and airborne LLW effluents. The strategy for solid LLW management incorporates the following elements: the continuation of an aggressive waste reduction program involving waste generation reduction, volume reduction and treatment; characterization and classification of waste according to its hazard, as will be required by revised DOE Order 5820.2, Chapter III; and improved confinement of waste according to its hazard. In support of this strategy, an evaluation was conducted of potential conceptual designs for improved confinement of LLW at the INEL Radioactive Waste Management Complex (RWMC). A potential system for disposal at the RWMC of stackable waste, bulk wastes, and high radiation level waste of low curie content was determined. Criteria for selection of the system components included perceived regulatory requirements and site-specific operational needs.

138 (CONF-870859—Pt.1, pp 17-32) **Considerations and guidance in the design and construction of alternative LLW disposal facilities.** Kane, J.D.; Tokar, M. (Nuclear Regulatory Commission, Silver Springs, MD (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A milestone of the Amendments Act of 1985 related to alternative disposal methods requires the NRC to identify, by January 1988, all relevant technical information needed in support of a license application to design and construct a waste disposal facility, together with the technical requirements such facilities would need to meet. To meet this milestone, the NRC will supplement the technical guidance in existing regulatory documents that are primarily focused on trench-type burial, with guidance on the structural aspects of soil-covered alternative options that include below-ground vaults and earth-mounded concrete bunkers. Examples of review criteria to be presented in the supplemented Standard Review Plans are provided. The issues considered by the NRC staff and its consultants in developing the review criteria for the two alternatives are discussed. The criteria developed cover eight major categories of issues ranging from the loads imposed on the engineered structures through material quality and durability considerations. 12 references.

139 (CONF-870859—Pt.1, pp 33-42) **BNFL's strategy for the disposal of solid low level radioactive waste.** Forrest, C. (British Nuclear Fuels, Risley (England)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The main activities of British Nuclear Fuels plc (BNFL) are: the purification and processing of uranium ore concentrates (at Springfields); the enrichment of uranium (at Capenhurst); the manufacture of uranium and plutonium based fuels (at Springfields and Sellafield); the operation of reactors (at Sellafield and Chapelcross); the reprocessing of irradiated fuel (at Sellafield); and the transportation of nuclear material. Like all complex industrial activities the above operations result in the formation of waste. The purpose of this paper is to describe BNFL's strategy for the disposal of solid low level waste. BNFL owns and operates a disposal site, known as the Drigg Storage Depot, which is located in West Cumbria about 4 miles southeast of Sellafield. The site not only handles solid low level waste generated as a result of the Company's fuel cycle business but also provides a disposal service to other producers of solid low level waste. The operations at the Drigg Site are described.

140 (CONF-870859—Pt.1, pp 43-60) **Long term management of low- and medium level radioactive waste in France: practices and plans.** Hutchison, C.A. (NUMATEC (France)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The size of the French nuclear program and the widespread use of radioelements in hospitals, in industry, and in research require a radioactive waste management organization on a national scale. The government created the French National Waste Management Agency, or ANDRA, which is responsible for the management of long term disposal sites and the siting, implantation, design, and construction of new disposal sites. This paper discusses these objectives of ANDRA and the integrated radioactive waste management system of France; describes the Centre de la Manche, the first disposal facility in France for short-lived low- and medium-level radioactive waste; and highlights the status of the second disposal facility planned for France, describing planned design, waste isolation system, and site selection.

141 (CONF-870859—Pt.1, pp 61-70) **Influences of engineered barrier systems on low-level radioactive waste disposal.** Buckley, L.P. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

There are major differences between the current practices of shallow land burial and alternative concepts for the disposal of low-level radioactive wastes. Additional protection provided with engineered barrier systems can overcome major concerns the public has with shallow land burial: subsidence; percolating ground waters; radionuclide migration; and, the vulnerability of shallow trenches to intrusion. The presence of a variety of engineered barriers to restrict water movement, retain radionuclides and to prevent plant animal or human intrusion leads to significant changes to input data for performance assessment models. Several programs which are underway to more accurately predict the long-term performance of engineered barriers for low-level waste are described.

142 (CONF-870859—Pt.1, pp 71-78) **Comparative assessment of alternative concepts for low-level radioactive waste disposal.** Rogers, V.C.; Baird, R.D.; Conner, J.E. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A conceptual design report was developed for DOE's Nuclear Energy Low-Level Waste Management Program to assist states and regions in developing new low-level radioactive waste (LLW) disposal sites in accordance with the requirements of the Amendments Act. Conceptual designs were developed for the following low-level radioactive waste disposal technologies: shallow land disposal, intermediate depth disposal, below-ground vaults, above-ground vaults, modular concrete canisters, and earth mounded concrete bunkers. The principal purpose of this report is to describe and evaluate several widely considered concepts for LLW disposal. General needs for information are satisfied by this report; however, specific individual requirements are not addressed. The report: (1) formulates and presents a design basis for conceptual designs; (2) provides descriptions of disposal facilities for six LLW disposal concepts; (3) evaluates the technical performance of six LLW disposal concepts, in terms of peak annual dose to off site individuals and workers; and (4) estimates life cycle costs and evaluates disposal economics for six LLW disposal concepts.

143 (CONF-870859—Pt.1, pp 79-94) **Radioactive materials users' view of alternative technologies for disposal of low-level radioactive waste.** Pasternak, A.; Cohen, J.J. (Alan D. Pasternak Consulting, Inc., Sacramento, CA (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

In 1982, following an extensive rule making, the US Nuclear Regulatory Commission adopted Title 10 Part 61 of the Code of Federal Regulations, Licensing Requirements for Land disposal of Radioactive Waste. Since then, the subject of so-called alternative technologies for the disposal of low-level radioactive waste has attracted the interest of state and compact officials, the National Governor's Association, vendors of alternative techniques, and

others. In some cases, interest in disposal technique has taken precedence over finding a disposal site. The implication of alternative disposal techniques for: disposal facility development time, public safety, occupational exposure, cost and cost-effectiveness, and reliability of governmental processes are examined from the point of view of users of radioactive materials who need the new disposal capacity which has been mandated by the Low-Level Radioactive Waste Policy Act. Cal Rad, the California association of radioactive materials users, has concluded that a sensible engineering approach to timely development of a safe, reliable, cost-effective disposal facility for low-level radioactive wastes is to first select a disposal facility for low-level radioactive wastes is to first select a disposal site that can meet the requirements of 10 CFR 61 and then to decline what, if any, enhancements are needed or desirable at that site. 16 references.

144 (CONF-870859—Pt.1, pp 95-99) **Concept for mixed low-level waste disposal that addresses NRC and EPA requirements.** Greeves, J.T.; Tokar, M. (Nuclear Regulatory Commission, Washington, DC (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

In this paper, a design concept for a mixed low-level waste disposal facility that addresses the regulatory requirements of the NRC and EPA is discussed. The facility incorporates EPA-required liners and a leachate detection, collection and removal system, as well as the NRC 10 CFR Part 61-required features. The design concept is based on an earth-mounded above grade tumlus. In this design, the double liners and leachate collection and removal system are contained within a layer whose placement precedes the emplacement of the mixed low-level waste and cover system. The NRC requirement for minimizing contact of the waste with water (and avoiding the bathtub effect) would be met by placing the waste above the level of the highest elevation of the leachate collection system liners. Details of the leachate collection, detection, and removal system, the waste cover, and the overall facility concept are discussed. The design approach has been developed by NRC and EPA.

145 (CONF-870859—Pt.1, pp 100-107) **West Valley demonstration project low-level waste management update.** Maestas, E.; McIntosh, T.W. (Dept. of Energy, West Valley, NY (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The West Valley Demonstration Project, directed by the US Department of Energy, is at the site of the only commercial nuclear fuel reprocessing facility to have operated in the US. Operation of the plant ceased in the early 1970s. It was determined in 1980 that the facility provided a unique opportunity for proving established nuclear waste management technology related to both high-level and low-level wastes. As mandated by Congress, the Project's overall goal is to demonstrate the solidification of approximately 2271 m^3 (600,000 gallons) of high-level nuclear waste and its shipment to a federal repository. In addition, the treatment and conditioning for disposal of the low-level wastes generated as a result of high-level waste solidification activities is to be performed. This paper discusses the progress made to date with the low-level waste treatment systems. Plans for interim waste storage at the facility are also described.

146 (CONF-870859—Pt.1, pp 108-110) **Alternative disposal technologies for the Central States Compact region.** Paton, R.F. (Ecology Nuclear, Louisville, KY (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

In February 1987, the Central States Compact Commission (Arkansas, Kansas, Louisiana, Nebraska and Oklahoma) issued a request for proposals (RFP) for companies interested in siting and developing a regional low-level radioactive waste facility for their region. The RFP stated that preference would be given to proposals that provided multiple engineered barriers. In addition, three of the region's states enacted legislation prohibiting traditional shallow-land burial or other below ground waste disposal options. In response to the Central States RFP, US Ecology proposed an above-grade disposal system comprised of above-grade vaults, concrete canisters and a multiple layered cap. The design option was selected by the Commission in July, and the company is proceeding to develop criteria for host state and site selection. This paper summarizes the status of the project.

147 (CONF-870859—Pt.1, pp 111-120) **Alternative disposal technologies for new low-level radioactive waste disposal/storage facilities at the Savannah River Plant.** Cook, J.R. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW. Contract AC09-76SR00001.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A Draft Environmental Impact Statement for Waste Management Activities for ground water protection has been prepared for the Savannah River Plant. Support documentation for the DEIS included an Environmental Information Document on new radioactive waste disposal and storage facilities in which possible alternative disposal technologies were examined in depth. Six technologies which would meet the needs of the Savannah River Plant were selected for description and analysis: (1) Near Surface Disposal, (2) Near Surface Disposal with Exceptions, (3) Engineered Storage, (4) Engineered Disposal, (5) Vault Disposal of Untreated Waste, and (6) A Combination of Near Surface Disposal, Engineered Disposal, and Engineered Storage.

148 (CONF-870859—Pt.1, pp 121-144) **Engineered storage facility for low level waste at Karlsruhe, Federal Republic of Germany.** Kraemer, R.; Stegmaier, W. (Karlsruhe Nuclear Research Center (West Germany)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Since 1978 the only disposal site (ASSE) for LLW in the FRG has not been licensed for active operation. Therefore nuclear power plants and other radwaste producers have to store their wastes in interim storage facilities until new disposal sites can be licensed. Waste accumulation of about two decades has to be properly managed. The paper gives an overview on LLW volume in the FRG presently stored and the quantity expected to be generated before the new disposal site for LLW, i.e. the KONRAD mine at Salzgitter, will be available. As an example the engineered storage facility for LLW at Karlsruhe is described with respect to design criteria, regulatory requirements, facility features, operating experience, and cost evaluation. These costs are compared with costs for waste treatment, packaging, transport and disposal. As a result only a few percent (1-2%) of the total costs are related to interim storage.

149 (CONF-870859—Pt.1, pp 145-156) **Development of a mixed waste disposal facility at the NTS.** Dickman, P.T.; Kendall, E.W. (Science Applications International Corp., Las Vegas, NV (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

In 1984, a law suit brought against DOE by the Legal Environmental Assistance Fund resulted in the requirement that DOE be subject to regulation by the state and US Environmental Protection Agency (EPA) for all hazardous wastes, including mixed wastes. Therefore, all DOE facilities generating, storing, treating, or disposing of mixed wastes will be regulated under the Resource Conservation and Recovery Act (RCRA). In FY 1985, DOE Headquarters requested DOE low-level waste (LLW) sites to apply for a RCRA Part B Permit to operate radioactive mixed waste facilities. An application for the Nevada Test Site (NTS) was prepared and submitted to the EPA, Region IX in November 1985 for review and approval. At that time, the state of Nevada had not yet received authorization for hazardous wastes nor had they applied for regulatory authority for mixed wastes. The status of the planned mixed waste site for NTS is described. Issues still to be resolved are

discussed: strategic alternatives study; exemptions requested; permit conditions; and mixed waste certification plans.

150 (CONF-870859—Pt.1, pp 157-172) **LLW disposal in a reactor containment building.** Eng, R.; Ostrow, S.L. (Ebasco Services Inc., New York, NY (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

This November marks the third time that a state-wide referendum is on the election ballot to shutdown the Maine Yankee Nuclear power plant in Maine. The Maine Yankee facility is the principal low level radioactive waste (LLW) generator in the state. Because of the low population density, the quantity of institutional LLW generated in Maine is quite low, less than 400 cubic feet/year. To date, the state of Maine has decided not to join any LLW interstate compact. To address these local issues, Maine Yankee has proposed an alternative disposal concept that will make maximum utilization of the existing Maine Yankee site. Ebasco Services Incorporated (EBASCO) was commissioned by Maine Yankee Atomic Power Company to define and examine the technical feasibility of employing a reactor containment building for LLW disposal. In this concept, all LLW generated in Maine is stored at the Plant site until the Maine Yankee reactor plant is ready for decommissioning. While the balance of plant is decommissioned, the reactor containment building is employed as a surface vault for LLW disposal. This study surveyed the major technical feasibility issues of this concept, but it did not include a review of the institutional and economic issues.

151 (CONF-870859—Pt.1, pp 173-183) **Slag-based saltstone formulations.** Langton, C.A. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013144/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Approximately 400 x 10^6 liters of low-level alkaline salt solution will be treated at the Savannah River Plant (SRP) Defense Waste Processing Facility (DWPF) prior to disposal in concrete vaults at SRP. Treatment involves removal of Cs^+ and Sr^{+2} followed by solidification and stabilization of potential contaminants in saltstone, a hydrated ceramic waste form. Chromium, technetium, and nitrate releases from saltstone can be significantly reduced by substituting hydraulic blast furnace slag for portland cement in the formulation designs. Slag-based mixes are also compatible with Class F fly ash used in saltstone as a functional extended to control heat of hydration and reduce permeability. (Class F fly ash is also locally available at SRP.) A monolithic waste form is produced by the hydration of the slag and fly ash. Soluble ion release (NO_3^-) is controlled by the saltstone microstructure. Chromium and technetium are less leachable from slag mixes compared to cement-based waste forms because these species are chemically reduced to a lower valence state by ferrous iron in the slag and precipitated as relatively insoluble phases, such as $CR(OH)_3$ and TcO_2.

152 (CONF-870859—Pt.2, pp 1-7) **Role of the public in siting and regulatory issues.** Monti, G.D. Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Both commitment of the public to the issues and commitment to public involvement by policy makers are discussed. In implementing the Low Level Radioactive Waste Policy Act, the use of the following techniques have proved effective in some siting cases: balanced advisory committees, economic incentive packages, assistance to communities, impact assistance, role for local government in oversight of operations, and education. Observations are made about two regulatory issues: the exemption of same radioactive waste streams from disposal in waste facilities because they are considered Below Regulatory Concern and export/import restrictions between regional Compact boundaries.

153 (CONF-870859—Pt.2, pp 8-16) **Change in United Kingdom policy on the disposal of low-level radioactive waste.** Curd, P.J. (United Kingdom NIREX, Ltd.). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

On May 1st, the Secretary of State for the Environment told the House of Commons that he had accepted the Nirex recommendation to abandon its shallow LLW disposal program and that the company had embarked on a program that would lead to the establishment of a multi-purpose deep repository for low and intermediate-level radioactive wastes soon after the turn of the century. The immediate reason for the Nirex recommendation was that the preliminary findings of site investigation and conceptual design work carried out in 1986/87 indicated that meeting ever more demanding criteria for shallow disposal of low-level waste alone had pushed the estimated cost of LLW disposal into the area of costs attached to adding a low-level waste facility to the deep ILW repository already planned for operation between the years 2000-2005. While not immediately conclusive and based on best estimates the figures were nevertheless firm enough to show that the shallow disposal of LLW alone was difficult to justify when an extra measure of public confidence could be gained by settling the safety argument once and for all by putting all wastes deep. It is important to note that site investigations and design work had shown to the company's satisfaction that shallow disposal (10-15 meters deep in clay) would have been perfectly satisfactory from a technical point of view and that each of the four sites investigated in southern and eastern England would have been adequate for development. With the decision made to cease work on the shallow disposal program the deep disposal program which had enjoyed less priority for the last two years became the company's major technical project.

154 (CONF-870859—Pt.2, pp 17-22) **Importance of early public involvement.** Anderson, G. Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Decision makers are beginning to recognize that early public involvement can be the difference between success and failure as far as a controversial project such as a low level radioactive waste disposal site is concerned. The public should be brought in from the beginning of the process: while all prospective sites are being considered, before the preferred site is named, before environmental impact hearings, and before licensing hearings. Using California as an example, the efforts used to site a low-level radioactive waste disposal facility are described. The involvement of a citizens advisory committee is highly recommended.

155 (CONF-870859—Pt.2, pp 23-29) **State legislators' needs and concerns in dealing with low-level waste management issues.** Werts, M. Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The situation in Kansas pertaining to site selection of a low-level radioactive waste facility is discussed. Public relations have not been handled successfully and site selection now faces an active opposition. Kansas is one member of a compact commission and questions are raised about emergency ship-ins from other regions, waste stream characterization, liability coverage, and legality of agreements between the Compact Commission and the host state (not chosen as yet).

156 (CONF-870859—Pt.2, pp 30-38) **Nuclear insurance - a facility operator's viewpoint.** Dillon, B. (Ecology Corp., Louisville, KY (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The issue of nuclear insurance has received increased prominence as the Compact system has moved forward in accordance with the Low-Level Radioactive Waste Policy Amendments Act of 1985. Recent declarations by American Nuclear Insurers (ANI), the primary carrier of liability insurance for nuclear facilities and the

sole insurer of low-level waste disposal sites, that they are reviewing the policies they have issued and that they may not issue policies for new facilities has cast a major question on the insurability of nuclear facilities. The current position of ANI should not, in any way, hinder the development of the Compact sites, as insurance is only one of many ways in which to deal with third-party liability and, in fact, may not, as it is presently constituted, be the best way to deal with the potential liabilities associated with a low-level nuclear waste facility. Two forms for liability policies are described along with their exclusions. The risk management analysis of low-level radioactive waste facilities is described. Finally the role of nuclear insurance in Compact development is discussed.

157 (CONF-870859—Pt.2, pp 51-63) **Below Regulatory Concern rule making in Texas: disposal of short-lived wastes in municipal landfills.** Pollard, C.G.; McBurney, R.E. (Texas Low-Level Radioactive Waste Disposal Authority, Austin (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Texas has recently completed rule making activities that allow the disposal of low-level wastes containing short-lived radionuclides in sanitary landfills. The rule is based on a technical study performed by Rogers and Associates Engineering Corporation for the Texas Low-Level Radioactive Waste Disposal Authority. The technical report was presented to the Texas Bureau of Radiation Control in support of a request for rule making. Radiation Control staff reviewed the study and formally proposed regulations based on the study's results. After a public comment period, the rule was adopted by the Texas State Board of Health. The rule went into effect May 8, 1987. This paper summarizes the technical study, the actual rule making process, and, finally, a licensing action allowing this method of disposal.

158 (CONF-870859—Pt.2, pp 64-79) **Economics of EPA's BRC criterion: impacts and implications.** Foutes, C.E. (Environmental Protection Agency, Washington, DC (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

As part of its overall Low-level Radioactive Waste Disposal Standard the EPA is considering proposing a Below Regulatory Concern (BRC) criterion. Such a BRC criterion would allow certain very low activity radioactive wastes to be disposed of in other than regulated radioactive waste disposal sites. Such BRC wastes would produce, as a result of unregulated disposal, an annual exposure to a defined Critical Population Group (CPG) of less than a certain millirem level. In support of this effort the EPA has conducted an economic analysis of the costs and health impacts of alternative levels of a BRC criterion. Surrogate BRC waste streams were selected, disposal scenarios developed and evaluated, and CPG doses and population health effects calculated. Based upon the risk and cost estimates for both regulated and unregulated disposal, the cost-effectiveness of alternative millirem levels of a BRC criterion was analyzed. Estimates were also made of the associated potential population health effects, total waste volumes deregulated, disposal cost savings, and the sensitivity of these factors to different assumptions regarding the implementation of a BRC criterion. Among the potential annual exposure levels analyzed were 15, 4, 1, and 0.1 millirem. The analysis demonstrated that there were both large volumes of low-level waste that could be deregulated and large disposal cost savings to be realized at most of these alternative BRC criteria levels. It was also found that the method in which a BRC criterion is implemented by the respective Federal agencies involved affected, to a large extent, the number of estimated population health effects associated with these alternative BRC levels. 15 references, 8 tables.

159 (CONF-870859—Pt.2, pp 80-84) **Revision of DOE Order 5820.2 Chapter III. Management of low-level waste.** Logan, J.A.; Dolenc, M.R.; Halford, D.K.; Kennedy, W.E. Jr. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The purpose of the revision of Chapter III is to increase its scope of coverage, from providing little more than guidance for the disposal of low-level waste (LLW), to defining DOE's overall policies covering all aspects of the management of DOE's low-level waste, and providing prescriptive requirements covering waste generation (including minimization), treatment, storage and disposal. The revised Chapter III, Low-Level Waste Management, will: (1) implement applicable EPA standards; (2) provide performance objectives to guarantee the health and safety of the: off-site population, intruder (archaeologist, builder), and water resources of nearby residents; (3) address entire waste management system - generation through long-term care; (4) accommodate site differences between the sites; (5) be enforceable and auditable by DOE and its water disposers; and (6) be cost effective to taxpayer. The program draft is in final revision and has been discussed with DOE-HQ and with disposal site representatives. The approach for DOE waste classification system has been agreed to and the preliminary system has been drafted.

160 (CONF-870859—Pt.2, pp 85-90) **Impacts of the emerging low level radioactive waste disposal system on large generators.** Birch, M.L. (Duke Power Co., Charlotte, NC (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The large low level radioactive waste generators, commercial power reactors, have a history of utilizing volume reduction. Most power reactors have implemented the straightforward cost-effective volume reduction techniques. Further volume reduction is mandated by the Low-Level Radioactive Waste Policy Amendments Act of 1985; further volume reduction requires sophisticated volume reduction systems installed at either power reactors or centralized facilities. These sophisticated systems require large capital investments and long lead times to fabricate and install. The volumes of waste disposed of at the present disposal sites is far below the volume caps; the costs to dispose of a cubic foot of waste have increased to cover the fixed costs of operating the disposal site. The emerging low level radioactive waste disposal system increases the number of sites and the sophistication of the disposal facility which increases the fixed costs of operating the disposal site, which, in turn, increases the costs to dispose of a cubic foot of waste. How much money should large generators invest to further reduce radwaste volumes when the unit costs of disposal will increase to compensate for the reduced volume?

161 (CONF-870859—Pt.3, pp 1-11) **DOE performance assessment guidance.** Case, M.J.; Otis, M.D. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

This document provides guidance for conducting a radiological performance assessment of a Department of Energy (DOE) low-level radioactive waste (LLW) disposal, treatment, or storage facility. The guidance is specifically intended to provide the fundamental approach necessary to meet the performance assessment requirements of DOE Order 5820.2, Chapter III. The document is written for LLW facility operators or other waste management personnel who will manage the performance assessment task. It is also intended to provide guidance for conducting performance assessments in a generally consistent manner at all DOE LLW disposal, treatment, and storage facilities. The guidance includes: a summary of performance objectives to be met by LLW disposal, treatment, and storage facilities derived from current DOE and other applicable federal regulatory guidelines; specific criteria for an adequate performance assessment from which a minimum set of required calculations may be determined; recommendations of methods for screening critical components of the system that should be addressed in detail; recommendations for the selection of existing models and the development of site-specific models; recommendations of techniques for comparison of assessment results with performance objectives; and a summary of reporting requirements. For the purpose of this document, radiological performance assessment

is defined as a systematic analysis of a LLW treatment, storage, or disposal facility and its environs for the purpose of demonstrating compliance with specific radiological performance objectives for protection of the public. The definition does not address worker protection or the non-radiological components of LLW.

162 (CONF-870859—Pt.3, pp 12-26) **Sensitivity analysis of EPA's codes used to assess health impact from LLW disposal alternatives.** Bandrowski, M.S. (Environmental Protection Agency, Washington, DC (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Environmental Protection Agency (EPA) is developing generally applicable environmental standards for land disposal of low-level radioactive wastes (LLW). An important part of EPA's standards development process is the comparison of potential health impacts from the disposal of LLW under a wide range of disposal alternatives and hydrogeologic and climatic conditions. EPA has developed the PRESTO-EPA family of risk assessment codes to estimate these health impacts. Because the PRESTO-EPA codes were developed specifically for the LLW standard setting effort and are new codes, a program of sensitivity analysis was conducted. In the sensitivity analyses, input parameters were systematically varied to identify those parameters having pronounced impact on code output. Scenario sensitivity analyses were also performed, in order to determine how pronounced an impact the assumptions regarding their disposal scenarios had on the model output. This paper describes the sensitivity analysis methodology, what tests were performed, and gives results and conclusions. Also included is a summary of the results of the LLW health impact assessments and a short description and results of the uncertainty analysis of the PRESTO-EPA models.

163 (CONF-870859—Pt.3, pp 48-59) **Assessing the performance of engineered barriers and materials for confinement of low-level radioactive waste.** Gilbert, T.L.; Camasta, S.F.; Meshkov, N.K. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW. Contract W-31-109-ENG-38.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The overall performance of a low-level radioactive waste disposal facility is determined by the facility design and site environment. In order to take credit for facility design features, such as engineered barriers, methods for assessing the performance of these features are needed. The objective of the work summarized in this status report is to develop such methods. It involves the following tasks: deriving performance criteria from the performance objective; identifying models and parameters for estimating the performance; and reviewing available methods and data for determining parameter values. 16 references.

164 (CONF-870859—Pt.3, pp 60-74) **New low-level radioactive waste disposal/storage facilities at the Savannah River Plant: performance assessments.** Sutherland, A.A.; Grant, M.W.; Cook, J.R. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW. Contract AC09-76SR00001.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Savannah River Plant will soon begin construction of a new facility for the disposal and storage of low-level radioactive waste. Initial planning for the facility included performance assessments of possible disposal technologies. The determination of input parameters and the interpretation of the results provided valuable insight into the process of performance prediction. Factors such as leach mechanisms and solubility controls of migrating species required particularly careful evaluation. 12 references, 3 tables.

165 (CONF-870859—Pt.3, pp 75-90) **Assessing waste management systems using REGINALT software.** Meshkov, N.K.; Camasta, S.F.; Gilbert, T.L. (Argonne National Lab., IL (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW. Contract W-31-109-ENG-38.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Low-level waste is often treated, packaged, or stored prior to disposal. All the steps taken in managing the waste (i.e., generation, treatment, packaging, storage, transportation, and disposal) constitute a waste management system. An optimal waste management system should provide an adequate margin of public, occupational, and environmental safety in a cost-effective manner over both the short and long term. To accomplish this, DOE has initiated a systems approach for managing waste. It essentially consists of tailoring the methods used for managing waste to suit the quantities and characteristics of the waste, while taking into account the characteristics of the disposal site. The task discussed in this paper is to provide methods and procedures that will enable managers to review an entire waste management system from generation to disposal in order to assess its performance. More specifically, the aim is to develop an efficient and practical method for comparing costs, benefits, risks, and trade-offs at all stages of waste management. A model called REGINALT was recently developed at EG & G Idaho, Inc., to allow the commercial sector to analyze the various treatment and disposal options available for handling a wide variety of waste streams. This model is reviewed here with respect to its potential usefulness for assessing DOE waste management systems. The model is well designed and simple to use, and can easily be augmented to provide a very useful tool for DOE waste managers. The REGINALT system and recommendations for its modification are discussed. 23 references.

166 (CONF-870859—Pt.3, pp 91-109) **Performance assessment methods for mixed waste sites at the Savannah River Plant.** King, C.M.; Marter, W.L.; Looney, B.B.; Pickett, J.B.; Till, J.E.; Meyer, K.R.; Merrel, G.C.; Rogers, V.C.; Holton, G.A.; Montague, D.F. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Liquid basins and solid waste disposal facilities have been considered in the qualitative risk assessment process for protection of ground water quality at the Savannah River Plant (SRP). This paper is concerned with identification of contaminants present at SRP waste sites and providing semi-quantitative methods and parameters for assessing the relative human health risk if such contaminants are subject to transport or migration by water or atmospheric pathways and, as a result of such transport, enter the human food chain. The methods for chemical and radionuclide risk assessment presented herein are similar to the methods now under development for the US Department of Energy (DOE) Office of Environment, Safety and Health by Battelle Pacific Northwest Laboratory for the Remedial Action Priority System (RAPS) for use by nationwide DOE installations for evaluation of the relative hazard of waste facilities by semi-quantitative risk assessment and follow the state-of-the-art review on risk assessment and waste site ranking methods recently published for the DOE. 23 references.

167 (CONF-870859—Pt.3, pp 110-115) **Sensitivity analysis of predictive models with an automated adjoint generator.** Pin, F.G.; Oblow, E.M. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The adjoint method is a well established sensitivity analysis methodology which is particularly efficient in large-scale modeling problems. Its efficiency comes from the fact that the coefficients of sensitivity of a given response with respect to every parameter involved in the modeling code can be calculated from the solution of a single adjoint run of the code. Sensitivity coefficients provide a quantitative measure of the importance of the model data in calculating the final results. The major drawback of the adjoint method which has prevented its widespread use in computational systems is the requirement for calculations of very large numbers of partial derivatives in order to set up the adjoint equations of the model. ADGEN is a software system which has been designed to eliminate this drawback and automatically implement the adjoint formulation in computer codes. In this paper, the ADGEN system is described

and its use for improving performance assessments and predictive simulations is discussed.

168 (CONF-870859—Pt.3, pp 116-128) **Probabilistic assessment of NTS site performance.** Cox, N.D. (EG & G Idaho Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The demonstration facility for great depth burial in alluvial sediments at the Nevada Test Site (NTS) utilizes boreholes that are 120 feet deep and 10 feet in diameter. These boreholes are intended for disposal of low-level waste considered unsuitable for shallow-land burial because of its high specific activity or its potential for migration into biopathways. The handling of the high specific activity waste is accomplished with a crane that is remotely controlled from a steel-wall control room. A 20-foot tall earthen barrier (or dike) is emplaced between the borehole and the control room for partial shielding. Contingency plans for equipment failure events are in place and are part of the training of the work crew. Because of the newness of the concept, every step is worked out in detail. In order to confirm the adequacy of the procedures and contingency plans, a probabilistic risk analysis for occupational radiation exposure is included as part of the project. With such a risk analysis it is possible to relatively rank the seriousness of a contingency, along with its probability of occurring. The results of this occupational risk analysis are presented as the first part of this paper. While the occupational risk analysis was underway, there arose the issue of the survivability of the adjacent shallow land burial site under monster flash flood conditions. One opinion was that the shallow-land site would not survive such a flood and would release its contents to flow down slope to Frenchman Playa. However, there was no quantification of this opinion. Therefore, a probabilistic risk analysis was undertaken to assess the possibilities of release of containers of radioactive waste from burial. The results of this analysis are presented as the second part of this paper.

169 (CONF-870859—Pt.3, pp 129-136) **Special waste-form lysimeters - arid.** Jones, T.L.; Serne, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW. Contract AC06-76RL01830.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The release of contaminants from solidified low-level waste forms is being studied in a field lysimeter facility at the Hanford Site in southeastern Washington State. Duplicate samples of five different waste forms have been buried in 10 lysimeters since March 1984. Waste-form samples represent three different waste streams and four solidification agents (masonry cement, Portland III cement, Dow polymer, and bitumen). Most precipitation at the Hanford Site arrives as winter snow; this contributes to a strong seasonal pattern in water storage and drainage observed in the lysimeters. The result is an annual range in the volumetric soil water content from 11% in late winter to 7% in the late summer and early fall, as well as annual changes in pore water velocities from approximately 4 cm/wk in early spring to less than 0.01 cm/wk in early fall. Measurable quantities of tritium and cobalt-60 are being collected in lysimeter drainage water. Approximately 30% of the original tritium inventory has been leached from two lysimeters originally containing tritium. Cobalt-60 is present in all waste forms; it is being collected in the leachate from five lysimeters. The total amount released varies, but in each case it is less than 0.1% of the original cobalt inventory of the waste sample. Nonradioactive constituents contained in the waste form, such as sodium, boron, and sulfate, are also being leached.

170 (CONF-870859—Pt.3, pp 137-148) **Progress in development of an accelerated leach test for low-level radioactive waste forms.** Fuhrmann, M.; Pietrzak, R.; Dougherty, D.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW. Contract AC02-76CH00016.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Factors that accelerate leaching from solidified low-level radioactive waste are being investigated to develop a short-term leach test that can be used to predict long-term releases. Data from work with portland cement containing radioactive tracers indicate that elevated temperatures (up to 50°C or higher) can accelerate leaching of Cs-137 by at least a factor of eleven without changing the leaching mechanism. An 18 day leach test at 50°C provided the equivalent of 200 days data taken at 20°C. Portland cement containing 5 wt% Na_2SO_4 (as a simulated evaporator concentrate) also can be accelerated, but to a lesser degree. Solid phase analysis indicated that pore plugging and increased tortuosity may be the cause of the smaller acceleration. Reduced specimen size was also a useful acceleration factor with inhomogeneities not being a problem in very small specimens. Elevated pH and 100 ppm EDTA in leaching solutions increased Sr-85 releases without altering Cs-137 leaching. 9 references, 10 figures, 1 table.

171 (CONF-870859—Pt.3, pp 149-159) **Environmental conditions important for safety assessments of alternatives to shallow land burial.** Otis, M.D. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The purpose of this paper is to summarize the approach developed for addressing environmental conditions important for safety and performance assessment of alternatives to shallow land burial of low-level radioactive waste. This is a continuation of work previously published as a failure analysis of engineered barriers in low-level-waste disposal. That volume identified the major engineered components of several disposal alternatives and examined the degree to which each alternative depended on these components to fulfill the functions of a disposal facility. The method used took into account the degradation of disposal system function resulting from all combinations of failure among the components of each alternative. The results of the analysis identified which components of the selected alternatives are most important to each of the functions of a near-surface disposal system, ranking them according to their contribution to the performance of each function. The failure analysis was intended as a screening device for identifying the most important engineered barriers. The objective of the extension of that analysis is to further investigate the mechanisms and rates of failure for these important components. This provides a technical basis that will assist in developing performance criteria and support the licensing of the design, siting, construction, operation, and closure of alternative methods for the disposal of low-level nuclear waste.

172 (CONF-870859—Pt.3, pp 160-172) **Development of an international BRC limit.** Kennedy, W.E. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW. Contract AC06-76RL01830.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The International Atomic Energy Agency (IAEA) has recently been investigating the exemption from regulatory control of radiation sources containing limited quantities of radioactive materials. Early efforts were entitled de minimis and were aimed at establishing a philosophical basis and radiation dose limits. The main objectives of the more recent work on exemption are (1) to illustrate a method for developing practical radiological criteria, (2) to establish generic criteria, and (3) to determine the practicability of the preliminary exemption principles. The method used to develop the criteria relies on models to evaluate the potential radiation exposure pathways and scenarios for individuals and population groups potentially present following the unrestricted release of materials. This paper describes the assessment methods, presents the generic results (expressed in terms of the limiting concentrations of selected radionuclides in municipal waste), and provides a comparison with recent regulatory efforts in the US for considering selected wastes as being Below Regulatory Concern (BRC). 17 references, 4 tables.

173 (CONF-870859—Pt.3, pp 173-177) **IMPACTS - BRC: is it adequate?.** Smith, C.F.; Cohen, J.J. (Science Applications International Corp., Pleasanton, CA (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

IMPACTS-BRC is an NRC-sponsored performance assessment computer code intended to extend the 10 CFR 61 Impacts Methodology to waste streams that can be considered to be Below Regulatory Concern (BRC). Several studies have applied this code to date, and additional efforts are under way to review and evaluate the code. Insights derived in these studies are presented and discussed in this paper. Any appropriately developed computer model can be considered to have both positive and negative features. It is important to view the adequacy of any modeling tool in the context of its intended use and application. Application of IMPACTS-BRC for various purposes has resulted in the identification of several problems with the program and its default data files. Nevertheless, the approach taken in the development of the code represents a noteworthy advance toward a standardization performance assessment tool. Such a standardized basis for BRC assessment is a highly desirable objective and warrants appropriate efforts to fully certify and implement the IMPACTS-BRC code.

174 (CONF-870859—Pt.4, pp 1-6) **Low-level waste classification system.** Halford, D.K.; Kennedy, W.E.; Farris, W.T. (EG & G Idaho, Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013147/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

As part of the revision of Department of Energy (DOE) Order 5820.2, Chapter III, a low-level radioactive waste (LLW) classification system is being developed. The waste classification system is designed to protect the public from short-term and long-term risk from radiation exposure during the waste management process which includes operational, closure, surveillance/observation, active institutional control and passive institutional control periods at the waste management site. The LLW classification system developed for DOE LLW disposal sites is being based on the scenarios and assumptions identified by the Nuclear Regulatory Commission (NRC) for 10 CFR 61 and use of the recommendations of the ICRP 26 and 30, as adopted by the DOE. Use of ICRP 26 and 30 led to DOE intruder dose performance objectives of 100 mrem/yr effective dose equivalent (EDE) for continuous exposures and 500 mrem/yr EDE for short-term exposures (NRC used 500 mrem/yr dose equivalent for all intruder scenarios), and the DOE (ICRP 30 based) internal dose conversion factors (versus the NRC (ICRP 2 based) dose conversion factors). The DOE waste classification system guidelines, being developed from the DOE performance objectives and ICRP 30 dose conversion factors, will be more conservative than their NRC counterparts. Two waste classes (as opposed to three used by the NRC) are also being considered. The development of the DOE waste classification system, the differences and similarities between the NRC and DOE system and the potential ramifications are discussed.

175 (CONF-870859—Pt.4, pp 7-19) **Ontario Hydro's radioactive waste characterization program and its application to waste management.** Dalziel, B.P.; Krasznai, J.P.; Krochmalnek, L.S.; Williamson, A.S. (Ontario Hydro, Toronto (Canada)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013147/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

By the 1990s, 14.5 GW(e) of Ontario Hydro's generating capacity will be provided by the CANDU (CANadian DEUterium) pressurized heavy water reactor system. It is estimated that based on existing waste treatment facilities about 2000 m^3 of processed and unprocessed solid radioactive waste will be generated per year during this period. In addition to these routinely generated waste streams, there are periodic large scale maintenance programs, decontaminations and chemical cleaning efforts which will cause transient increases in the chronic waste generation rate. Until a permanent disposal facility is available all radioactive waste is placed in engineered storage systems located at the Bruce Nuclear Power Development (BNPD) site. Recognizing the long term benefits of knowing the chemical and radiochemical composition of the various waste streams, Ontario Hydro undertook to systematically characterize the low and intermediate level waste generated. This paper describes the methods used, the results of the investigations and the end uses of this information.

176 (CONF-870859—Pt.4, pp 20-32) **Safety issues related to disposal of I-129 in a low level radioactive waste repository.** Bhattacharyya, A.K.; Nanati, R.; Shearer, T. (Pennsylvania Dept. of Environmental Resources, Harrisburg (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013147/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The isotope I-129 has unfavorable characteristics as regards its disposal in a Low Level Radioactive Waste (LLRW) repository. Not only is its half-life very long (1.70×10^7 years), it also exhibits physical and chemical properties which facilitate its transport in the ground water system once released from the repository. Although the amounts of I-129 produced in the reactors (and otherwise) can reasonably be expected to be small, even small amounts could cause safety concern. Simple model calculations show that in any release scenario, the total integrated population doses will grow to be dramatically high, particularly if the cutoff assumptions regarding space (Basin Population) and time (e.g. 1000 years) are relaxed. A rough estimate of the correction factor was obtained via a simple calculation based on radially dispersing plume, uniform population density and other similar grossly simplifying assumption. The results indicate that assuming a 1000 year cutoff could potentially underestimate the population doses by as much as a factor of 25,000. No doubt such doses stretch out into the future and should be appropriately discounted. Nevertheless, the concern is legitimate and needs attention. As a result of the deliberations above, the authors embarked on the following program: (1) examine the source term for generation of I-129; (2) examine the 10CFR61 conformant generic safety/licensing analysis for conceptual repositories; and (3) make appropriate conclusions, and to the extent practicable, proper recommendations. 16 references, 5 tables.

177 (CONF-870859—Pt.4, pp 33-46) **Information requirements for the Department of Energy Defense Programs hazardous and mixed wastes.** Herron, S.A. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013147/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Department of Energy Defense Programs (DOE-DP) provide and maintain a nuclear weapons complex for safeguarding national security. DP operates 16 production, processing, testing, and research and development (R & D) installations in 13 states, which generate radioactive and hazardous chemical wastes. This paper describes the users of DP hazardous and mixed waste data and cites examples of how it is used. Also provided are descriptions and status of specialized information systems, which encompass aspects of hazardous and mixed waste technology.

178 (CONF-870859—Pt.4, pp 47-55) **Assessment of mixed hazardous and radioactive waste sites at Hanford.** McLaughlin, T.J.; Cramer, K.H.; Lamar, D.A.; Sherwood, D.R.; Stenner, R.D.; Schulze, W.B. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013147/JAW. Contract AC06-76RL01830.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The US Department of Energy and Pacific Northwest Laboratory recently completed a preliminary assessment of 685 inactive hazardous waste sites located on the Hanford Site. The preliminary assessment involved collecting historical data and individual site information, conducting site inspections, and establishing an environmental impact priority, using the Hazard Ranking System (HRS), for each of these 685 sites. This preliminary assessment was the first step in the remediation process required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This paper presents the results of that preliminary assessment.

179 (CONF-870859—Pt.4, pp 56-71) **Characterization of waste streams on the Oak Ridge Reservation.** Rivera, A.L.; Osborne-Lee, I.W.; Butcher, B.T. Jr.; Jackson, A.M.; Van Cleve, J.E Jr. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013147/JAW. Contract AC05-84OR21400.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

For the foreseeable future, the Oak Ridge Reservation (ORR) plants will generate solid low-level waste (LLW) that must be disposed of or stored on-site. The available disposal capacity of the current sites is projected to be fully utilized during the next decade. During the 1980s, several factors coincided which made the process of developing new disposal sites significantly more difficult. An LLW disposal strategy has been developed by the Low-Level Waste Disposal Development and Demonstration (LLWDDD) Program as a framework for bringing new, regulator-approved disposal capacity to the ORR. An increasing level of waste stream characterization will be needed to maintain the ability to effectively manage solid LLW by the facilities on the ORR under the new regulatory scenario. In this paper, current practices for solid LLW stream characterization, segregation, and certification are described. In addition, the waste stream characterization requirements for segregation and certification under the LLWDDD Program strategy are also examined.

180 (CONF-870859—Pt.4, pp 72-82) **New requirements for waste stream characterization.** Fauver, S.L. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013147/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Radioactive Waste Management Project (RWMP) is responsible for the operation, maintenance, and surveillance of radioactive waste management sites at the Nevada Test Site (NTS). Since FY 1978, the RWMP has managed over eight million cubic feet of defense low-level wastes (LLW) generated both on site and offsite. RWMP operates two principal facilities. Packaged LLW is disposed by shallow land burial (SLB) or greater confinement disposal (GCD). Pits and trenches, ranging in 20 to 30-foot depths and 120-foot augered shafts, are used for the disposal of packaged wastes. Bulk LLW is disposed in subsidence craters in a landfill operation. 97% of all packaged wastes received at NTS are generated offsite. 98% of all bulk wastes received result from NTS Waste Consolidation Project efforts. Since its initiation in 1976, the Waste Consolidation Project has removed over four million cubic feet of soil and debris from inactive waste storage sites located at NTS for disposal at the Radioactive Waste Management Site (RWMS). This paper describes the Radioactive Waste Management Information System used to meet low-level waste reporting requirements.

181 (CONF-870859—Pt.4, pp 7-13) **Long-term stability considerations in the design of erosion protection covers for LLW disposal units.** Johnson, T.L. (Nuclear Regulatory Commission, Silver Springs, MD (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013148/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Disposal of low-level radioactive waste must be accomplished in accordance with NRC's requirements in 10 CFR Part 61. These regulations envision that waste disposal units containing Class B & C wastes be designed to remain stable for 500 years, with no reliance placed on active maintenance, to the extent practicable. The design of protective covers for such disposal units will be significantly affected by the selection of the design flood event and the need to prevent the initiation of gullying. In reviewing cover designs to assure long-term stability, the NRC staff has concluded that the use of covers designed to withstand a probable maximum flood (PMF) will meet the long-term stability requirements of 10 CFR Part 61. The use of such a design basis will generally result in conservative measures which assure the long-term stability of conventional low-level disposal units and above-ground engineered alternatives.

182 (CONF-870859—Pt.4, pp 14-24) **Low-level liquid waste disposal site remediation technology development at the Hanford Site.** Phillips, S.J.; Relyea, J.F. (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013148/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Westinghouse Hanford Company is developing technologies supporting long-term physical stabilization and isolation of liquid waste materials in underground waste disposal crib and caisson structures. Prototype equipment and methodologies are being developed to dynamically consolidate and/or inject durable materials into and proximal to these structures. To date, testing, development, and demonstration of a mobile in situ waste treatment system for site remediation of liquid waste disposal sites has been completed. Continued testing and development activities are in progress for in situ treatment of contaminated, industrial, solid low-level waste materials. Conceptual design activities have also been initiated to develop an injection system for application to low-level waste underground tank and vault remediation.

183 (CONF-870859—Pt.4, pp 25-35) **Remedial action - Maxey Flats low-level waste disposal site, CERCLA action.** Haight, C.P.; Mills, H.D. (Kentucky Dept. for Environmental Protection, Frankfort (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013148/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Maxey Flats Radioactive Waste Disposal Facility in Fleming County, Kentucky has been added to the National Priority List and will undergo remediation and closure under Superfund. The required closure of the facility to the further acceptance of waste was taken to alleviate and correct water management, environmental, and public health and safety concerns at the facility. Based upon the fact that trench leachate has been demonstrated to be moving via a sandstone lens which forms the bottom of most of the trenches, the state has indicated to the US EPA that this facility should receive a high priority for remediation and closure. In 1984 the site was evaluated using the standard Mitre Hazard Ranking and the US EPA proceeded with a review which was culminated by inclusion on the NPL and preparation of a Forward Planning Study (FPS). A Work Plan for a Remedial Investigation/Feasibility Study (RI/FS) as required by Superfund was then prepared by the US EPA for implementation. A notice of potential liability was sent to 832 Potentially Responsible Parties (PRP's) in November 1986. The PRP's identified were state, local and federal agencies; nuclear power stations; hospitals, clinical laboratories, physicians; industrial users; transporters; site operator; landowner and numerous other categories of nuclear material users. The larger volume PRP's have formed an Executive Committee and signed a Consent Order in March 1987 with the US EPA to perform the RI/FS Work Plan. The small volume PRP's have also formed a working group to negotiate a settlement with the US EPA as provided by the SARA amendments of Superfund. History and status of remedial action at the site are described.

184 (CONF-870859—Pt.4, pp 36-41) **Site management activities preceding closure of a low-level radioactive waste disposal area.** Hornibrook, C. (New York State Energy Research and Development Authority, Albany (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013148/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The New York State Energy Research and Development Authority (Energy Authority) cofunded a project with the US Department of Energy (DOE) to identify and evaluate options for long-term site management at the West Valley LLRW disposal area. During the course of the project, continued Active Maintenance/Final Closure was selected as the preferred option. At that point, Envirosphere Company, the Energy Authority's contractor conducting the project, developed a proposed detailed Interim Site Management Plan identifying maintenance, monitoring and remedial programs to be conducted over time at the disposal area. This paper discusses the maintenance, monitoring and remedial programs proposed by the contractor, the Energy Authority's in-house eval-

uation of those proposed programs, and factors that are influencing the Energy Authority's development of its Interim Site Management Plan and action plan to implement the management plan.

185 (CONF-870859—Pt.4, pp 42-62) **Development of an arid site closure plan.** Nyhan, J.W.; Barnes, F.J. (Los Alamos National Lab., NM (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013148/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The purpose of this task is to develop a prototype plan for the effective closure and stabilization of an arid low-level waste disposal site. This prototype plan will provide demonstrated closure techniques for a trench in a disposal site at Los Alamos based on previous NLLWMP-sponsored SLB field research both at the Los Alamos Experimental Engineered Test Facility, and at two waste disposal areas at Los Alamos. The accuracy of modeling soil water storage by two hydrologic models, CREAMS and HELP, was tested by comparing simulation results with field measurements of soil moisture in eight experimental landfill cover systems having a range of well-defined soil profiles and vegetative covers. Regression analysis showed that CREAMs generally represented soil moisture more accurately than HELP simulations. Precautions for determining parameter values for model input and for interpreting simulation results are discussed. A specific example is presented showing how the field-validated hydrologic models developed in this endeavor can be used to develop a final prototype closure plan. 15 references, 13 figures.

186 (CONF-870859—Pt.4, pp 63-76) **Program for closure of an inactive radioactive waste disposal site at the Savannah River Plant.** Cook, J.R. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013148/JAW. Contract AC09-76SR00001.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The 643-G Radioactive Waste Disposal Facility was operated at the Savannah River Plant from 1952 through 1974, and has been inactive since that time. The actions leading to closure of 643-G will involve a combination of activities consisting of limited waste removal, stabilization, capping, and monitoring. The overall effect of these closure actions will be to place the 643-G site in a physically and chemically stable state which will remain stable over a long period of time. During a 100 year institutional control period surveillance and monitoring of the site will be carried out to verify that the performance of the system is acceptable, and access of the general public to the site will be restricted. The program described in this paper is a recommendation; the actual closure plan will be negotiated with regulatory authorities.

187 (CONF-870859—Pt.6, pp 1-10) **Status of NRC's waste form regulatory guide.** Jungling, T.L.; McDaniel, K.K.; Person, L.S.; Tokar, M. (Nuclear Regulatory Commission, Silver Springs, MD (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013149/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Nuclear Regulatory Commission's (NRC's) 1983 Technical Position on Waste Form is being modified for publication as a Regulatory Guide. The Regulatory Guide necessitates the testing of low-level waste forms to demonstrate stability. As a result, vendors have performed and supported extensive research and testing, results of which are included in their topical reports. In the course of NRC's review of these topical reports, the NRC has identified some areas that require further evaluation. Included among these are (1) cement waste form long-term structural stability, (2) bitumen waste form strength and viscosity characteristics, and (3) polyethylene high integrity container (HIC) structural stability. To expedite their resolution, the NRC will encourage vendor participation in addressing these issues. This paper discusses current NRC activities and strategy for dealing with the complex technical issues on waste form stability and describes laboratory testing and analyses, performed by Brookhaven National Laboratory, which play a supportive role in resolving these issues. Discussion is also included on the schedule for further NRC action in implementing waste form requirements.

188 (CONF-870859—Pt.6, pp 11-22) **Low-level radioactive waste disposal/treatment technology overview - Savannah River Site.** Sturm, H.F. Jr. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013149/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Savannah River site will begin operation of several low-level waste disposal/treatment facilities during the next 5 years. These will include a new low-level solid waste disposal facility, a low-level liquid effluent treatment facility, and a low-level liquid waste solidification process. Closure of a radioactive hazardous waste burial ground will also be completed. In addition, significant technical effort is directed toward waste volume reduction. These programs include compaction, incineration, waste avoidance, and clean waste segregation. This paper summarizes these activities with emphasis on new technology being developed and implemented. 11 references.

189 (CONF-870859—Pt.6, pp 23-35) **Evaluation of waste treatment technologies by LLWDDD program.** Kennerly, J.M.; Williams, L.C.; Dole, L.R.; Genung, R.K. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013149/JAW. Contract AC05-84OR21400.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

LLW has been divided into four classes. Class I consists of materials that, at the time of disposal, contain contaminants yielding a dose to man that is less than an allowable limit. Disposal would be in an industrial-type landfill. Class II, principally for disposal of short-half-life isotopes, provides engineered barriers that would contain the radionuclides, with the goal of zero release during a period of decay. Class III disposal, less well-defined than other disposal classes, is designed to accept wastes contaminated by long-half-life radionuclides that contain a soluble fraction that can be removed by leaching during the period of institutional control. Class IV, which includes all other wastes that are not acceptable for disposal on-site, may be treated to convert the majority of the material to a lower classification for disposal on-site. Waste treatments are divided in to four categories: (1) volume reduction; (2) conditioning to improve waste form performance; (3) segregation to achieve waste reduction; and (4) separation to remove radioactive (or hazardous) constituents. Two waste treatment demonstrations are described. In the first, volume reduction by mechanical means was achieved during the supercompaction of 300 55-gal drums of solid waste at ORNL. In the second demonstration, conditioning of waste through immobilization and packaging to improve the performance of the waste form is being evaluated. Potential scenarios are described for the management of uranium-contaminated wastes at the Y-12 Plant in Oak Ridge emphasizing where demonstrations of treatment technology will be needed to implement the scenarios. Separation and thermal treatment are identified as the principal means for treating these wastes.

190 (CONF-870859—Pt.6, pp 36-43) **Improved treatment of slightly radioactive process waste: reduced generation of waste.** Berry, J.B.; Robinson, S.M. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013149/JAW. Contract AC05-84OR21400.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

Discontinuation of the hydrofracture disposal method at Oak Ridge National Laboratory (ORNL) has caused intensive efforts to reduce liquid waste generation. Improving the treatment of slightly radioactive process waste has reduced the volume of a liquid low-level radioactive waste (LLLW) secondary waste stream by 66%. Proposed processing improvements could eliminate all LLLW and reduce solid low-level waste by an additional 1/3. The improved process meets stringent discharge limits for radionuclides. Discharge limits for radionuclides are expected to be enforced at the outfall of the treatment plant to a creek; currently, limits are enforced at the reservation boundary. Plant discharge is monitored according to the National Pollutant Discharge Elimination System (NPDES) permit for ORNL.

191 (CONF-870859—Pt.6, pp 44-58) **Solidification of commercial and defense low-level radioactive waste in polyethylene.** Franz, E.M.; Heiser, L.H.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013149/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A process has been developed for the solidification of salt wastes, incinerator ash and ion-exchange resins in polyethylene. Of the salt wastes, sodium sulfate and boric acid are representative of the wastes produced at commercial nuclear facilities while sodium nitrate is a typical high-volume waste generated at defense-related facilities. Ease of processibility and high loading efficiencies were obtained through the use of low-density polyethylene (0.917 to 0.924 g/cm^3) with melt indices ranging from 2.0 to 55.0 g/minute. The process utilized a commercially available single-screw extruder to incorporate the wastes into the polyethylene at about 120°C to produce a homogeneous mixture. Although present studies utilize dry wastes, wet wastes can also be processed using vented extruders of the type used commercially for the bitumen solidification process. Tests were performed on the waste forms to determine leachability, according to the ANS 16.1 Method, and mechanical properties. In the case of waste forms containing nitrate salt waste, the EPA Extraction Procedure was also used. To confirm the compatibility of polyethylene and nitrate salt waste at elevated temperatures, the self-ignition temperatures were measured and a differential scanning calorimeter was used to characterize the thermal behavior of oxidizing compounds contained in the simulated waste, as well as the real Savannah River Plant waste. No exothermic reactions were observed over the temperature range studied from 50°C to 400°C.

192 (CONF-870859—Pt.6, pp 59-72) **Waste minimization program at the Feed Materials Production Center.** Blasdel, J.E.; Crotzer, M.E.; Gardner, R.L.; Kato, T.R.; Spradlin, C.N. (Westinghouse Materials Co. of Ohio, Cincinnati (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013149/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A waste minimization program is being implemented at the Feed Materials Production Center to reduce the generation of uranium-contaminated wastes and to comply with existing and forthcoming regulations. Procedures and plans are described which deal with the following wastes: process and non-process trash, contaminated wood and metals, used metal drums, and major process wastes such as contaminated magnesium fluoride and neutralized raffinate. Waste minimization techniques used include segregation, source reduction, volume reduction, material substitution and waste/product recycle. The importance of training, communication, and incentives is also covered.

193 (CONF-870859—Pt.6, pp 73-83) **Reduction of low-level radioactive waste at the Oak Ridge Y-12 Plant.** Bailey, J.K.; Butcher, B.T.; Simon, K.F. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013149/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

A portion of the Y-12 Plant's mission includes casting, rolling, and machining depleted uranium metal (99.8% of U-238) required to produce a finished product. These operations result in a variety of combustible and noncombustible waste streams. Solid, low-level radioactive waste accounted for 31,000 m^3 or approximately one third of the total volume of solid waste generated by the Y-12 Plant in FY86. The contamination level in this waste ranges from essentially uncontaminated up to 450 nCi/gm, the specific activity of Y-12 depleted uranium. The majority of this waste is disposed of in an on site, shallow-land burial facility. Historically, segregation of clean from uranium contaminated trash has been based on knowledge of process/production areas and limited administrative controls on disposition of trash dumpsters. Current Oak Ridge Operations strategies being studied indicate that increasingly stringent disposal controls will be applied to solid, low-level waste based on activity level considerations. Implementation of these strategies hinge upon the ability to measure radioactivity at levels currently below regulatory concern. A new waste monitoring technique, waste separation efforts, and efforts at source identification are described.

194 (CONF-870859—Pt.6, pp 84-89) **Savannah River Plant low-level waste segregation program.** Wheeler, V.B. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013149/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

In an effort to extend the life of the Savannah River Plant (SRP) Radioactive Waste Burial Ground, a sitewide program has been implemented to segregate waste that is essentially free of contamination from routine radioactive waste. Waste studies at SRP have shown that much of the low-level waste disposed of as radioactive has no detectable contamination and can be buried in a sanitary landfill. A Landfill Monitoring Facility (LMF) will be constructed at SRP to house the state-of-the-art technology required to provide a final survey on the candidate waste streams that had previously been classified as radioactive. The LMF is scheduled for startup by October 1987.

195 (CONF-871075—Vol.1-Pt.2, pp 95-118) **Stabilization of radioactive liquid process waste at ORNL.** Scott, C.B. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

After describing radiochemical and chemical composition of typical process waste water, a review of the various waste processing techniques that have been used prior to 1984 is given. In 1984 the hydrofracture operation was shutdown and ORNL had to quickly find means to reduce liquid low level radioactive waste generation before the storage area was filled. A clarifier was reinstalled at the head of the process flowsheet and results of this waste reduction are given. In 1987 a zeolite column was added to the process waste treatment plant for the removal of cesium 137. A flow sheet of the existing waste water treatment plant and radiochemical concentrations of the effluent are given.

196 (CONF-871075—Vol.1-Pt.2, pp 123-148) **Permitting a hazardous waste incinerator.** Ambrose, M.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

In recent years, changes in the laws and regulations have produced an increased emphasis on proper solid waste disposal. Experience with various types of industrial wastes has shown that a large segment of these materials should not go to a landfill. If these wastes are prohibited from landfills, an effective alternative is incineration. The Department of Energy (DOE) has seen the need to build an incinerator at the Oak Ridge Gaseous Diffusion Plant to treat wastes that are generated at the DOE-Oak Ridge Operations facilities, many of which are contaminated with low levels of radioactivity. An extensive effort has been put forth to bring this project to reality. Several permits from the Environmental Protection Agency and the Tennessee Department of Health and Environment are required before the facility can operate. These permits include: (1) Resource Conservation and Recovery Act Part B Permit, (2) Toxic Substances Control Act Permit, (3) National Pollutant Discharge Elimination System Permit, (4) Tennessee State Air Permit, and (5) National Emission Standard for Hazardous Air Pollutants Approval Letter. The permitting process has been very long and involved and has taken nearly three years to complete. Currently, plans are to have the facility fully operational by January 1988.

197 (CONF-871075—Vol.1-Pt.2, pp 149-168) **Solid low-level waste certification program at ORNL.** Wheeler, M.C.; Bates, L.D. (Automated Sciences Group, Inc., Oak Ridge, TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Over the past several years increased awareness and concern has developed regarding the proper generation, packaging, transporting and storing of all forms of waste matter, including Solid Low-Level Radioactive Waste (SLLW). Recently, special attention has been given to the proper segregation of waste types to prevent unauthorized and unregulated storage or disposal of waste matter. In April, 1986, the Oak Ridge National Laboratory (ORNL) embarked on a rigorous program to upgrade its SLLW management program. This waste certification effort included such elements as waste generator identification, training, procedure development, quality assurance, safety analysis and As Low As Reasonably Achievable (ALARA) studies. This paper provides an overview of this effort and identifies the techniques employed to develop a SLLW certification at ORNL.

198 (CONF-871075—Vol.1-Pt.2, pp 187-197) **Effect of biomonitoring requirements on the operation of a biological/chemical waste water treatment process.** Taylor, P.A.; Zabelsky, K.; Kingrea, R.H.; Stewart, A.J. (Oak Ridge Y-12 Plant, TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Nitrate containing waste water at the Oak Ridge Y-12 Plant is biodenitrified in six large stirred-tank reactors, and then aerated to bio-oxidize any remaining organics. After decanting from the settled solids, the water is chemically treated and discharged. The Decant Treatment Facility (DTF) consists of acidification to remove carbonates, precipitation with ferric chloride, lime, and powdered activated carbon at a pH of 7.5-8.0, and filtration. During startup of this process chemical and biomonitoring tests showed that the process produced water that met the chemical requirements of the NPDES permit; however, the biomonitoring results were unfavorable (LOEC = 0.1%). Laboratory tests showed that increasing the pH of the precipitation step to 10.0, followed by neutralization and final filtration would significantly reduce the uranium concentration and the toxicity of the treated decant water. Parallel experiments examined the toxicity of the primary chemical contaminants that were present in the treated effluent. These test showed that sodium, chloride, and sulfate were relatively nontoxic (LOEC > 15 mM); potassium, bicarbonate, and calcium were moderately toxic (LOEC < 10mM); and lithium and uranium were quite toxic (LOEC < 1mM).

199 (CONF-871075—Vol.1-Pt.2, pp 287-307) **Demonstration test operation of the Feed Materials Production Center biodenitrification facility.** Patton, J.B.; Benear, A.K. (Westinghouse Materials Co. of Ohio, Cincinnati (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A fluidized-bed biological denitrification (BDN) system was used to treat high-nitrate waste water streams from a DOE owned uranium processing plant. A two-column system (half of a proposed four-column production facility) was used to demonstrate BDN operation on a production scale. The BDN facility has been successfully operated since mid-May. In a continuous 200 hour rate determination period, the BDN processed over 1.6 million gallons that contained over 4700 kilograms of nitrate and nitrite nitrogen. The BDN removed an average 97% of the incoming nitrate and nitrite. The BDN effluent was discharged to the FMPC sewage treatment plant where it caused increased levels of BOD, TSS and fecal coliforms in the STP discharge. This indicated the BDN effluent will require treatment prior to discharge to the environment. Preliminary chemical consumption rates and associated costs of operation were determined. Several modifications and additions to the system were identified as necessary for the permanent production facility.

200 (CONF-871075—Vol.1-Pt.2, pp 321-323) **Operational experience at the Sludge Treatment Facility.** Sy, D.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Sludge Treatment Facility (STF) at the Oak Ridge Gaseous Diffusion Plant has been in operation since April 1987. The facility was designed to encapsulate hazardous sludge wastes in a cement matrix. Fixation will allow the waste to meet or exceed applicable compressive strength and leachability requirements. Thus, the grout mixture complies with the Resource Conservation and Recovery Act (RCRA) guidelines as a nonhazardous waste. The grout mixture is based upon a recipe formulation developed after several years of waste stream characterization and formulation studies. The wastes to be treated at the STF are wastes impounded in two ponds. The ponds have a combined capacity of 4.5 million gallons of sludge. The sludge is transferred from the ponds to a 15,000-gallon capacity storage tank by the use of a dredge. The grout mixture recipe dictates the amount of sludge, cement, fly ash, and admixture required for weighing per batch. All ingredients are weighed and then transferred to a tilt or high energy mixer for mixing. The grout mixture is then transferred to 89- or 96-gallon steel drums. The drums are placed in a storage yard designed for a point source discharge from the yard.

201 (CONF-871075—Vol.1-Pt.2, pp 327-351) **Liquid low-level waste (LLLW) solidification at Oak Ridge National Laboratory.** Schultz, R.M.; Monk, T.H.; duMont, S.P.; Helms, R.E.; Keigan, M.V.; Morris, M.I. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

In general, the presentation describes the disposal of liquid, low-level (radioactive) waste (LLLW) by the hydrofracture process at Oak Ridge National Laboratory until 1984, when it was shut down due to regulatory concerns and operational anomalies. As a result of this, about 400,000 gallons of concentrated LLLW and 50,000 gallons of transuranic waste-bearing sludges have accumulated in the active, double-contained tank system which is reaching its operational capacity. A major initiative to develop an alternative means of LLLW treatment and disposal was begun about two years ago. This presentation summarizes the implementation strategy of the most likely process options. The strategy is being developed in two phases; a near-term flowsheet and a long-term or reference flowsheet. First, reliable and fully demonstrated commercial, cement solidification systems are being assessed for execution of an initial 50,000 gallon campaign in 1988. Second, development is under way to determine viable sludge separation, LLLW decontamination and solidification alternatives. A flowsheet analysis and cost study is being conducted by a consultant to ensure proper consideration of process developments at other sites. It is estimated that, depending upon funding requirements, it could take up to six years to implement the reference flowsheet.

202 (CONF-871075—Vol.1-Pt.2, pp 353-371) **Stabilization of solid wastes containing technetium-99 for the Portsmouth Gaseous Diffusion Plant.** Shoemaker, J.L.; Bostick, W.D.; Spence, R.D.; Gilliam, T.M.; Morgan, I.L. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Technetium-99 is a relatively high-yield, long half-life fission product of enriched uranium. The authors describe initial studies on the applicability of concrete fixation for stabilizing selected mixed radioactive and chemically hazardous solid wastes from the Portsmouth Gaseous Diffusion Plant, with the primary objective of reducing the leachability of toxic metals (including cadmium, lead, and uranium), nitrate ion, and technetium. Containment of these leachable components is desired in order to facilitate permitting of above ground, long-term outdoor storage. Three waste forms were selected for this study: (1) a heavy metals sludge, resulting from cleaning and contamination activities; (2) an incinerator ash; and (3) a high acidic gunk sludge, resulting from recovery of uranium from spent trapping material. Concrete test specimens have been prepared using wastes blended with cement, fly ash, blast furnace slag, clay, and other additives. Solidified waste form leachability has been evaluated by the EP-toxicity characteristic and ANS-16.1-1986 procedures, and structural integrity evaluated by freeze-thaw, 90-day immersion, and compressive strength tests. Heavy metals con-

centrations in the EP-toxicity leachate were well below required limits, and (relative to leachate from the raw wastes) uranium, nitrate, and technetium-99 concentrations were reduced by approximately 7-, 6-, and 3-orders of magnitude, respectively.

203 (CONF-871075—Vol.1-Pt.2, pp 373-391) **Maxey Flats in situ waste grouting demonstration.** Razor, J.E.; Mills, D. (Westinghouse Electric Corp., Hillsboro, KY (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW. Contract FG07-81ID12223.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Maxey Flats Disposal Site located in Fleming County, Kentucky was added to the US EPA National Priority List in 1986 and is currently being evaluated for remediation and closure under the CERCLA/Superfund program. The Commonwealth of Kentucky has cosponsored a program with the US DOE Low Level Waste Management Program to demonstrate various remedial technologies which may be applied to source containment at the Maxey Flats site. This paper describes the field demonstration of in-situ waste grouting using a particulate (cement) grout. This demonstration is a follow-on to a similar demonstration using a solution grout. Both programs were designed to develop injection techniques, to assess the ability of the grout to fill the accessible voids within the waste/backfill matrix, to measure the reduction in the hydraulic conductivity of the waste/backfill matrix, and to determine the operational difficulties in implementing a site-wide grouting program. The paper concludes with lessons-learned during the project and estimated costs for full scale implementation.

204 (CONF-871075—Vol.1-Pt.2, pp 393-407) **Conceptual design for the demonstration and evaluation of stabilization and closure techniques of a low-level radioactive waste disposal site.** Cox, L.C. (Automated Sciences Group, Inc., Oak Ridge, TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Long term stabilization and closure of radioactive or hazardous waste disposal sites is a critical element in waste management which is presently undemonstrated. This report represents an integration of stabilization and closure methodology researched at ORNL and other locations into a design, and ultimately a demonstration of long term passive stabilization and closure techniques. The chosen demonstration site is a 19 trench low level waste disposal site within Solid Waste Storage Area (SWSA) No. 6 at ORNL. Design criteria included prevention of biological intrusion (animals and plant roots), waste stabilization, hydrological isolation, failure detection, run-off and infiltration monitoring, and passive performance evaluation capability. These criteria are satisfied through incorporation of these basic components: dynamic compaction; in situ chemical grouting; high density polyethylene (HDPE); high swelling bentonite; rock/gravel animal and root barrier; native soil cap; and under-cap and surface drainage.

205 (CONF-871075—Vol.1-Pt.2, pp 409-429) **Grouting as a waste immobilization/disposal method.** McDaniel, E.W. (Oak Ridge National Lab., TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Many options are available today for the immobilization and disposal of wastes that contain environmentally harmful materials. The option chosen depends upon the type of waste, regulatory requirements, and economics of process. Some options are specific to a given waste type; others are more versatile. This presentation discusses a very versatile option for waste immobilization/disposal, i.e. grouting. Many types of grout are available, such as chemical, clays or other particulates, fly ash, cements, or a combination of these. Within the limited allowable time, this presentation discusses the application of a variety of cement-based grouting techniques available for disposal of environmentally harmful materials. Areas discussed are in situ grouting of pits, ponds and lagoons, grouting as remedial action, and fixation for disposal in burial trenches or vaults.

206 (CONF-881054—18) **Assessment of potential worker exposure during the operational phase of the Tumulus Disposal Demonstration Project.** Styers, D.R.; Garland, S.B. II. (Oak Ridge National Lab., TN (USA); Automated Sciences Group, Inc., Oak Ridge, TN (USA)). 1988. Contract AC05-84OR21400. 10p. (CONF-881054—18). NTIS, PC A02/MF A01. Order Number DE89001578/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

The Oak Ridge National Laboratory has a continuing commitment to improve waste management and storage practices for solid low level radioactive wastes (LLW). The Tumulus Disposal Demonstration Project was chosen by the Low Level Waste Disposal Development and Demonstration (LLWDDD) program as one of the disposal technologies that is being evaluated to dispose of this waste in an environmentally acceptable manner. For this project, primary waste packages containing dry, solid LLW with contact dose equivalent rates less than 200 millirem per hour were placed into secondary concrete disposal vaults and the void spaces filled with a concrete grout mix. The completed units were then placed on the Tumulus pad: To assess potential worker sequence for this disposal technology, the radiation field at the site was surveyed. Measurements of worker exposures during the loading operations necessary to prepare and to emplace the LLW were conducted. The goal is to develop a database sufficient to compare worker exposures for disposal facilities of different designs. 14 refs., 1 fig., 1 tab.

207 (CONF-881054—19) **Systems analysis support to the Waste Management Technology Center.** Rivera, A.L.; Osborne-Lee, I.W.; DePaoli, S.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01. Order Number DE89001575/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

This paper describes a systems analysis concept being developed in support of waste management planning and analysis activities for Martin Marietta Energy Systems, Inc. (Energy Systems) sites. This integrated systems model serves as a focus for the accumulation and documentation of technical and economic information from current waste management practices, improved operations projects, remedial actions, and new system development activities. The approach is generic and could be applied to a larger group of sites. This integrated model is a source of technical support to waste management groups in the Energy Systems complex for integrated waste management planning and related technology assessment activities. This problem-solving methodology for low-level waste (LLW) management is being developed through the Waste Management Technology Center for the Low-Level Waste Disposal, Development, and Demonstration (LLWDDD) Program. In support of long-range planning activities, this capability will include the development of management support tools such as specialized systems models, data bases, and information systems. These management support tools will provide continuing support in the identification and definition of technical and economic uncertainties to be addressed by technology demonstration programs. Technical planning activities and current efforts in the development of this system analysis capability for the LLWDDD Program are presented in this paper. 2 refs., 5 figs., 1 tab.

208 (CONF-881054—21) **Design, construction, and operations experience with the SWSA 6 [Solid Waste Storage Area] Tumulus Disposal Demonstration.** Van Hoesen, S.D.; Van Cleve, J.E.; Wylie, A.N.; Williams, L.C.; Bolinsky, J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01. Order Number DE89001700/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

Efforts are underway at the Department of Energy facilities in Oak Ridge to improve the performance of radioactive waste disposal facilities. An engineered disposal concept demonstration involving placement of concrete encased waste on a monitored concrete pad with an earthen cover is being conducted. The design, construction, and operations experience with this project, the

SWSA 6 Tumulus Disposal Demonstration, is described. 1 fig., 1 tab.

209 **(CONF-881054—22) An overview of the waste handling and packaging plant, a major processing facility for remote-handled transuranic waste.** Turner, D.W.; Stewart, R.C.; du Mont, S.P. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01. Order Number DE89001698/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

The Waste Handling & Packaging Plant (WHPP) is a FY 1991 line item project proposed for construction at the Oak Ridge National Laboratory (ORNL). The purpose of the facility is to receive, package, certify and ship remote-handled (RH) and special case (SC) transuranic (TRU) waste to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The scope of the facility includes the mobilization of liquids and sludges from the Melton Valley Storage Tanks, transport of these liquids and sludges to the WHPP, solidification to a certifiable waste form, and final packaging and shipment to WIPP. Various solid hot cell wastes will be received at the WHPP from storage at ORNL and from other Department of Energy (DOE) sites. The solid wastes will be removed from the storage or shipping container, examined, processed as required, certified and packaged for shipment to WIPP. All packages coming from the processing cell will be in 55 gallon drums, and the facility will have the capability to load these directly into a shielded drum shipping cask, or to load these into the RH TRU canister for remote welding and shipment to WIPP using the RH TRU canister cask. 4 figs.

210 **(CONF-881054—24) The implications of RCRA [Resource Conservation and Recovery Act] regulation for the disposal of transuranic and high-level waste.** Sigmon, C.F.; Sharples, F.E.; Smith, E.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01. Order Number DE89001689/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

In May of 1987 the Department of Energy (DOE) published a rule interpreting the definition of "byproduct" under the Atomic Energy Act. This byproduct rule clarified the role of the Resource Conservation and Recovery Act (RCRA) in the regulation of DOE's radioactive waste management activities. According to the rule, only the radioactive portion of DOE's mixed radioactive and hazardous waste (mixed waste), including mixed transuranic (TRU) and high-level waste (HLW), is exempt from RCRA under the byproduct exemption. The portion of a waste that is hazardous as defined by RCRA is subject to full regulation under RCRA. Because the radioactive and hazardous portions of m any, if not most, DOE wastes are likely to be inseparable, the rule in effect makes most mixed wastes subject to dual regulation. The potential application of RCRA to facilities such as the Waste Isolation Pilot Plant (WIPP) and the HLW repository creates unique challenges for both the DOE and regulatory authorities. Strategies must be developed to assure compliance with RCRA without either causing excessive administrative burdens or abandoning the goal of minimizing radiation exposure. This paper will explore some of the potential regulatory options for and recent trends in the regulation of TRU and HLW under RCRA.

211 **(CONF-881071—1) Selection and treatment of priority liquid waste streams on the Oak Ridge Reservation.** Morris, M.I.; Kasten, J.L.; Dole, L.R.; Gilliam, T.M. (Oak Ridge National Lab., TN (USA); Qualtech, Inc., Oak Ridge, TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01. Order Number DE89000024/JAW.

From 49. international water conference; Pittsburgh, PA, USA (24 Oct 1988).

This program investigates and compares the different processes utilizing cement and bitumen for immobilization of the waste streams in (1) the development by vendors of specimen waste forms using surrogate waste formulas for testing and evaluation; (2) the bench-scale demonstrations on the actual wastes of the processes that have been demonstrated to be acceptable; and (3) the large-scale demonstration treating a statistically acceptable volume of the specific waste stream using a process satisfactorily demonstrated.

212 **(CONF-881120—5) Radiological health risks from accidents during transportation of spent nuclear fuels.** Chen, S.Y.; Yuan, Y.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012031/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

Potential radiological health risks from severe accident scenarios during the transportation of spent nuclear fuels are estimated. These extremely low probability, but potentially credible, scenarios are characterized by the U.S. Nuclear Regulatory Commission's Modal Study in terms of the maximum credible structural responses and/or the maximum credible cask temperature responses. In some accident scenarios, the spent nuclear fuel casks are assumed to be breached, resulting in the release of radioactivity to the atmosphere. Models have been developed to estimate radiological health consequences, including potential short-term exposures and health effects to individuals and potential long-term environmental dose commitments and health effects to the population. The population risks are calculated using state-level data, and the resulting overall health risks are compared for several levels of cleanup effort to determine the relative effects on long-term risks to the population in the event of an accident. 4 refs., 3 figs., 3 tabs.

213 **(DOE/OR/21548—033) Work plan for the remedial investigation/feasibility study-environmental impact statement for the Weldon Spring site, Weldon Spring, Missouri.** Peterson, J.M.; MacDonell, M.M.; Haroun, L.A.; Nowadly, F.K.; Knight, W.C.; Vajda, G.F. (MK-Ferguson Co., Weldon Spring, MO (USA); Argonne National Lab., IL (USA)). Aug 1988. Contract AC05-86OR21548;W-31109-ENG-38. 215p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE89002423/JAW.

The Weldon Spring Site Remedial Action Project is being conducted as a Major System Acquisition under the Surplus Facilities Management Program (SFMP) of the US Department of Energy (DOE). The major goals of the SFMP are to eliminate potential hazards to the public and the environment that are associated with contamination at SFMP sites and to make surplus real property available for other uses to the extent possible. The Weldon Spring site is located near Weldon Spring, Missouri, about 48 km (30 mi) west of St. Louis. It is surrounded by large tracts of land owned by the federal government and the state of Missouri. The site consists of four raffinate pits, an inactive chemical plant, and a contaminated quarry. The raffinate pits and chemical plant are on adjoining land about 3.2 km (2 mi) southwest of the junction of Missouri (State) Route 94 and US Route 40/61, with access from Route 94. The quarry is located in a comparatively remote area about 6.4 km (4 mi) south-southwest of the raffinate pits and chemical plant area; the quarry can also be accessed from Route 94. These areas are fenced and closed to the public. From 1941 to 1944, the US Department of the Army operated the Weldon Spring Ordnance Works, constructed on the land that is now the Weldon Spring site, for production of trinitrotoluene (TNT) and dinitrotoluene (DNT). The Army used the quarry for disposal of rubble contaminated with TNT. In the mid 1950s, 83 ha (205 acres) of the ordnance works property was transferred to the US Atomic Energy Commission (AEC); this is now the raffinate pits and chemical plant area. An additional 6 ha (15 acres) was later transferred to the AEC for expansion of waste storage capacity. 23 refs., 37 figs., 21 tabs.

214 **(DOE/RW—0006-Rev.4) Integrated data base for 1988: Spent fuel and radioactive waste inventories, projections, and characteristics.** (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 286p. (ORNL/M—640). H. Order Number TI89001961/JAW.

The Integrated Data Base (IDB) Program has compiled current data on inventories and characteristics of commercial spent fuel and both commercial and US government-owned radioactive wastes through December 31, 1987. These data are based on the most reliable information available from government sources, the open literature, technical reports, and direct contacts. The current

projections of future waste and spent fuel to be generated through the year 2020 and characteristics of these materials are also presented. The information forecasted is consistent with the latest US Department of Energy/Energy Information Administration (DOE/EIA) projections of US commercial nuclear power growth and the expected defense-related and private industrial and institutional (I/I) activities. The radioactive materials considered, on a chapter-by-chapter basis are: spent fuel, high-level waste, transuranic waste, low-level waste, commercial uranium mill tailings, remedial action waste, and decommissioning waste. For each category, current and projected inventories are given through the year 2020, and the radioactivity and thermal power are calculated based on reported or estimated isotopic compositions. In addition, characteristics and current inventories are reportd for miscellaneous, highly radioactive materials that may require geologic disposal. 89 refs., 46 figs., 104 tabs.

215 **(DP—1754) A computer model of gas generation and transport within TRU waste drums.** Smith, F.G. III. (Savannah River Lab., Aiken, SC (USA)). Jun 1988. Contract AC09-76SR00001. 49p. NTIS, PC A03/MF A01. Order Number DE89002387/JAW.

A computer model has been developed to predict radiolytic gas generation and transport within Transuranic (TRU) waste drums and surrounding enclosures. Gas generation from the radiolytic decomposition of organic material contaminated with plutonium is modeled and the concentrations of gas throughout the waste drum and enclosures are determined using a diffusional transport model. The model accurately reproduces experimentally measured gas concentrations. With polyethylene waste in unvented drums, the model predicts that the concentration of hydrogen gas can exceed 4 mole percent (lower flammable limit) with only about 5 curies of plutonium. If the drum liner is punctured and an unrestricted 0.75-in. carbon composite filter vent is installed in the drum lid, the plutonium loading can be increased to 240 Ci without generating flammable gas mixtures. Larger diameter filters can be used to increase the curie loading. The model has been used to show that shipments of 1000 Ci of plutonium-238 contaminated waste from Savannah River to the WIPP site are feasible using the TRUPACT shipping container. 10 refs., 17 figs., 6 tabs.

216 **(DPST—86-237) Agitation in DWPF Precipitate Pump Pit Tanks.** Marek, J.C. (Savannah River Lab., Aiken, SC (USA)). 20 Jan 1986. Contract AC09-76SR00001. 15p. NTIS, PC A03/MF A01. Order Number DE89002450/JAW.

An experimental program to test the reference agitator design for DWPF Precipitate Pump Pit Tanks has been completed. It was not known whether the reference agitator design would produce uniform mixing of precipitate slurry. There was also a concern that the reference agitator would produce excessive foaming of precipitate. An alternative agitator design that produces good mixing with little or no foam buildup was identified in the tests and is recommended for use in DWPF Precipitate Pump Pit Tanks. 7 refs.

217 **(DPST—86-275) Thermodynamic model of waste tank corrosion with implications to pitting during in-tank processing, washing and storage.** Bickford, D.F. (Savannah River Lab., Aiken, SC (USA)). 14 Feb 1986. Contract AC09-76SR00001. 29p. NTIS, PC A03/MF A01. Order Number DE89001637/JAW.

The electrochemical thermodynamics of iron dissolution can be applied to past studies of pitting and general corrosion of carbon steel waste tanks for the storage of radioactive waste. Such studies seek to reproduce in the laboratory the electrochemical conditions existing in waste tanks. The tests employed are either coupon tests in solutions intended to be typical of the environment, or potentiodynamic or potentiostatic tests which impress a voltage on the sample, and measure the resulting electric currents. All types of test samples are microscopically examined for crevice or pitting corrosion. This review discusses the electrochemical processes that occur during such testing. By stating the assumptions which are inherent in such testing, this review seeks to familiarize process engineers and chemists with the conditions favorable for pitting corrosion, and some of the means of controlling it. Also included is a review of the conditions which exist during the washing and storage of cesium tetraphenylborate, and high aluminum waste. Implications of the model to the chemical control of pitting during these processes are summarized, along with potential alternative methods of controlling the pitting. 29 refs., 8 figs., 8 tabs.

218 **(DPST—86-334) Heat transfer in DWPF Precipitate Pump Pit Tanks.** Marek, J.C. (Savannah River Lab., Aiken, SC (USA)). 14 Mar 1986. Contract AC09-76SR00001. 12p. NTIS, PC A03/MF A01. Order Number DE89002449/JAW.

An engineering analysis of heat transfer in DWPF Precipitate Pump Pit Tanks (PPPTs) was performed to determine whether excessive temperature rises would occur in the tanks. Heat is generated in the tanks by agitation and by decay of the radionuclides present in the precipitate slurry. The analysis indicates that no problems are expected because the rate of heat generation is low and hence a long time is required to achieve significant temperature rises. Free convection was found to be the dominant mode of heat transfer, because under normal operating conditions no air flows through the Pump Pits. The analysis indicates the temperature of the precipitate slurry will not rise above 80.1{degree}C, the normal boiling point (NBP) of benzene.

219 **(DPST—86-632) Summary of heat transfer models for the DWPF [Defense Waste Processing Facility], Scale and IDMS melters.** Nash, C.A. (Savannah River Lab., Aiken, SC (USA)). 27 Aug 1986. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01. Order Number DE89001410/JAW.

This document summarizes heat transfer models for the DWPF, Scale, and IDMS melters. This review should assist in pointing out areas where more modeling work is most greatly needed. 16 refs.

220 **(DPST—86-691) Comparison of West Valley and Savannah River waste glass: Part I, Durability of non-radioactive waste glass.** Jantzen, C.M. (Savannah River Lab., Aiken, SC (USA)). 29 Sep 1986. Contract AC09-76SR00001. 21p. NTIS, PC A03. Order Number DE89001413/JAW.

Simulated West Valley glass was prepared by Catholic University of America (CUA) and then tested at SRL. The simulated glass was non- radioactive (WV-205) and had ZrO_2 substituted for the ThO_2 component of the waste. The durability experiments demonstrated that WV-205 glass is of similar durability and composition to SRL-200 interim precipitate hydrolysis product (PHP) waste glass; WV-205 glass is not as durable as sludge-only SRL-165 but more durable than sludge-only SRL-131 waste glass formulations, and the relative durability of WV-205 glass can be assessed by hydration thermodynamics. 12 refs., 3 figs., 11 tabs.

221 **(DPST—86-767) Development of a glass durability test for the DWPF [Defense Waste Processing Facility].** Plodinec, M.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 12 Nov 1986. Contract AC09-76SR00001. 19p. NTIS, PC A03/MF A01. Order Number DE89001636/JAW.

The Defense Waste Processing Facility (DWPF) must be able to demonstrate that the durability of DWPF glass has been controlled. Several strategies for doing this are currently being explored. The most straightforward method of demonstrating this control is to test the durability of the glass directly. If this control strategy is selected, a quick test, sensitive to variations in glass durability, and suitable for routine use in the DWPF, will be needed. In this report, we detail the steps we are taking to develop this test, in the context of control strategies for the DWPF product. 2 refs.

222 **(DPST—87-242-Rev.) Estimation of permeability for cap design in MWMF [Mixed Waste Management Facility].** Yau, W.W.F.; Wilhite, E.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 9 Feb 1987. Contract AC09-76SR00001. 4p. NTIS, PC A02/MF A01. Order Number DE89001648/JAW.

To close the Mixed Waste Management Facility (MWMF), use of a clay cap to shield the wastes from precipitation is under consideration by Waste Management at the Savannah River Plant. The MWMF closure plan is subject to review and concurrence by the State of South Carolina. As part of the closure plan, SRP Waste Management is to supply information to the state concerning its engineering feasibility. By request of SRP Waste Technology, we have estimated the range of soil permeability and studied the practicability of a shielding cap to the MWMF; this memorandum reports our findings. 6 refs.

223 **(DPST—88-796) Estimation of Sm-151 from measured Pm-147.** Dewberry, R.A. (Savannah River Lab., Aiken, SC (USA)). 25 Aug 1988. Contract AC09-76SR00001. 4p. NTIS, PC A02/MF A01. Order Number DE89001411/JAW.

The attached procedure is a derivation to estimate Sm-151 activity in DWPF glass product and glass melter feed samples. Sm-151 is one of the radioactive fission product species in the glass product which will contribute greater than 0.05% of the total activity, and thus its content must be reported. We will not routinely perform elemental separation of Sm from Pm in the DWPF samples as they are received, but rather will report the Sm-151 activity as a constant fraction of the measured Pm-147 activity. Since Sm-151 decays with a 76 kev β-endpoint energy and is difficult to chemically separate from Pm, the direct measurement of Sm-151 content is technically very difficult. This document derives the multiplicative constant which will be used to estimate Sm-151 content from measured Pm-147 content, and the error which will be reported for each sample. A rigorous separation of Sm from Pm will be performed on selected samples to assure that the routine DWPF samples do not contain Sm-151/Pm-147 relative activities which deviate from the relationship derived here. Since both Sm-151 and Pm-147 can both be considered to be direct fission products with no other production pathway contributing, their relative production rate can be estimated from the U-235 fission yield curve. Ignoring burnup by neutron capture in a reactor irradiation, the relative activities of the two species is a function only of the decay rates. Sm-151 activity can then be estimated from measured Pm-147 activity, if some knowledge of irradiation time and decay time is available. The attached procedure explains the derivation and discusses the error obtained in the estimation.

224 **(GSF—10/88) HAW project. Demonstrative disposal of high-level radioactive wastes in the Asse salt mine. Interim report 1985-1987.** Rothfuchs, T.; Duijves, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung; Netherlands Energy Research Foundation, Petten). Apr 1988. 240p. (In German). (GSF-TL—19/88). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755160/JAW.

Since 1968 the GSF has been carrying out research and development programs for the final disposal of high-level radioactive waste (HAW) in salt formations. The heat producing waste has been simulated so far by means of electrical heaters and also cobalt-60-sources. In order to improve the final concept for HAW disposal in salt formations the complete technical system of an underground repository is to be tested in a one-to-one scale test facility. To satisfy the test objectives thirty high radioactive canisters containing the radionuclides Cs-137 and Sr-90 will be emplaced in six boreholes located in two test galleries at the 800 m-level in the Asse salt mine. The duration of testing will be approximately five years. For the handling of the radioactive canisters and their emplacement into the boreholes a system consisting of transportation casks, transportation vehicle, disposal machine, and borehole slider will be developed and tested. The actual scientific investigation program is based on the estimation and observation of the interaction between the radioactive canisters and the rock salt. This program includes measurement of thermally and radiolytically induced water and gas release from the rock salt and the radiolytical decomposition of salt minerals. Also the thermally induced stress and deformation fields in the surrounding rock mass will be investigated carefully.

225 **(IAEA-INFCIRC—352) Resolution on the dumping of nuclear and industrial wastes in Africa adopted by the Organization of African Unity.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1988. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704455/JAW.

The Resolution on the dumping of nuclear and industrial wastes in Africa was adopted in May 1988 at the 24th summit meeting of the Organization of African Unity (OAU), held in Addis Ababa (Ethiopia) and it was a subject of discussion at the June 1988 session of the Board of Governors.

226 **(IAEA-WMRA—18) Waste management research abstracts No. 18. Information on radioactive waste programmes in progress.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1987. 518p. NTIS (US Sales Only), PC A22/MF A01. Order Number DE88704486/JAW.

The eighteenth issue of this publication contains over 750 abstracts from 33 IAEA member countries comprehending various aspects of radioactive waste management. Radioactive waste disposal, processing and storage, geochemical and geological investigations related to waste management, mathematical models and environmental impacts are reviewed.

227 **(INIS-BR—1303) Safety analysis in subsurface repositories. Mathematical model and hydrodynamic dispersion.** (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Instalacoes e Materiais Nucleares). Jun 1985. 53p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704542/JAW.

The development of mathematical models to represent the repository-geosphere-biosphere system, and the development of a structure for data acquisition, processing, and use to analyse the safety of subsurface repositories, are presented. To study the behavior of radionuclides in geosphere a laboratory to determine the hydrodynamic dispersion coefficient was constructed. (M.C.K.).

228 **(INIS-BR—1305) IEN project - Fluidized bed burner.** (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Dept. de Instalacoes e Materiais Nucleares). Aug 1985. 44p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704544/JAW.

Due to difficulties inherent to the organic waste storage from laboratories and institutes which use radioactive materials for scientific researches, the Nuclear Facilities Division (DIN/CNEN); elaborated a project for constructing a fluidized burner, in laboratory scale, for burning the low level organic radioactive wastes. The burning system of organic wastes is described. (M.C.K.).

229 **(INIS-mf—11801) Standardization of containers for radwaste from operating and decommissioned nuclear facilities for final storage in Konrad mine. Revised version. As of November 1984.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekttraeger Universitaetsforschung zum Nuklearen Brennstoffkreislauf/Stillegung von Nuklearanlagen (PtUB/SN)). 1984. 45p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755166/JAW.

The compilation gives a survey on the present state of the investigations and talks on harmonization in the field of standardization of radioactive waste containers for final storage in the pit 'Konrad'. The results presented are contained i.a. in the final report of the GNS research project sponsored by the Federal Government: 'Preparation of an approvable technical concept for the packaging, conditioning, transportation and final storage of radioactive waste from closed-down nuclear installations' (FKZ 02 S 7092). The project was concluded on June 30, 1984.

230 **(INIS-mf—11825) Permeability of fissured rock - an experimental study with special regard to the water injection test.** Schneider, H.J. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Ingenieurgeologie und Hydrogeologie). Jun 1987. 304p. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88755288/JAW.

Mitteilungen zur Ingenieurgeologie und Hydrogeologie.; no. 26.

The permeability to water of fissured rock is one of the most important design parameters for many underground projects, such as, e.g. the final deposition of radioactive waste. Because the conventional water injection test according to LUGEON for the calculation of permeability to water is associated with a high degree of uncertainty, new test equipment was developed. This equipment works on the principle of the water injection tracer test and multilevel measurements, enabling detailed measurement of the flow process at injection site and in the rock. The tests were carried out in Bunter sandstone and granite. The LUGEON test concept was varied in short-term and long-term tests at identical geological boundary conditions, and with test control at constant pressure on the one hand and at constant injection volume on the other. The test results show that non-steady-state flow occurs with short injection times, whereby the range is limited to the local rock at injection site. An increasing in injection time can lead to an increase in range by a number of factors as well as to steady-state flow conditions. The permeability of the rock types investigated is not homgeneous and anistropic as a result of the fissured structure. (orig./HP) With 114 figs., 4 tabs.

231 **(IOS-Rep—217) CTD data from the Madeira Abyssal Plain. Charles Darwin Cruise 1/85.** Saunders, P.M. (Institute of Oceanographic Sciences, Godalming (UK)). 1985. 78p. (DOE-RW—85.181). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88780103/JAW.

This report presents lists and graphs of CTD data taken aboard RRS Charles Darwin during February 1985. The majority of the lowerings were made in support of two experiments; the deployment of deep SOFAR floats near 32 2 N 24 2 W and of moorings near 31 30 2 N 25 2 W (GME site). Others were made on a basin-wide section along 32 2 N. All CTD data is compared with reversing thermometer observations and with measurements of salinity and dissolved oxygen derived from samples.

232 **(IOS-Rep—221) Moored current meter data from the Madeira Abyssal Plain (GME). 1st deployment (1984).** Saunders, P.M. (Institute of Oceanographic Sciences, Godalming (UK)). 1986. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780107/JAW.

Near bottom current have been measured at three closely spaced sites in the N.E. Atlantic for 13 months. Locations were selected in the Great Meteor East study site area, near 31 2 30'N 25 2 W, one on the abyssal plain, one on top of a small abyssal hill about 400 m high and one on its flank just above the plain. Current meters were moored 10, 100, and 1000 m above the local bottom (543 8 m, 5398 m and 4999 m) in January 1984 and recovered in February 1985. This report displays the characteristics of the currents in numerous tables and figures. In the meantime they are found to be very weak and though adjacent moorings are separated by only 12 km and 27 km the year-long current directions differ radically. Current variations are principally due to semi-diurnal tides, inertial oscillations and eddies the latter of which migrate over the moorings. The tidal energy meets expectations as does the eddy energy with magnitude 2-3 cm 3 s 2] 2. Horizontal (isopycnal)diffusivity is estimated as about 2x10 2 m 2 s 2] 2. Currents 10 m above the bottom exceed 10 cm/s least frequently on the plain and most frequently at the hill-foot. The influence of the hill is surprisingly large. At all three sites the strongest currents are found near the sea bed. Speeds also show a Weibull distribution and rough 50 year return currents are inferred.

233 **(IOS-Rep—225) Great Meteor East: an interim report on biological sampling and general relationship to physical oceanography.** Roe, H.S.J.; Domanski, P.A.; Fasham, M.J.R. (Institute of Oceanographic Sciences, Godalming (UK); Department of the Environment, London (UK)). 1986. 60p. (DOE-RW—86.081). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780109/JAW.

The report deals with work carried out in June/July 1985 on RRS Discovery Cruise 156 to GME. The general physical oceanography of the area and the vertical distribution of chlorophyll and nutrients are described. Primary production measurements and results are discussed in detail. Biological sampling of Benthic and pelagic animals is described together with the subsequent laboratory treatment of the samples and some preliminary data on midwater biomass.

234 **(IOS-Rep—227) CTD data from the Madeira and Iberian Abyssal Plains. CHARLES DARWIN cruises 3/85 and 9A/85.** Saunders, P.M. (Institute of Oceanographic Sciences, Godalming (UK)). 1986. 55p. (DOE-RW—86.064). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780106/JAW.

This report presents lists and graphs of CTD data taken aboard RRS Charles Darwin on cruises 3 (May 1985) and 9A (November 1985). The majority of the lowerings were made in support of two experiments; the deployment of deep SOFAR floats and of deep moored current meters, the latter near 31 2 30'N 25 2 W (GME site). All CTD data is compared with reversing thermometer observations, and with determinations of salinity and dissolved oxygen from samples.

235 **(IOS-Rep—229) Dispersion of tracers by the oceanic eddy field modelling programme. Interim report, April 1986.** Richards, K.J. (Institute of Oceanographic Sciences, Godalming (UK); Department of the Environment, London (UK)). 1986. 27p. (DOE-RW—86.086). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780108/JAW.

A numerical model has been developed to study the dispersion of tracers by the oceanic eddy field. The study is designed to investigate the horizontal and vertical structure of the eddies and how this structure is influenced by the bottom topography. It is found that hills and valleys have a strong effect on the eddies above them. The flow close to the bottom has a tendency to be steered by the height contours. The surface and bottom flows become decorrelated and the vertical variation of the kinetic energy of the eddies is increased with higher topographic features.

236 **(Juel-Conf—60) MAW and HTR fuel element test disposal in boreholes.** Barnert, E. (ed.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung). Jul 1987. 225p. (In German). (CONF-8612164—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW.

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

The Kernforschungsanlage Juelich, KFA, (Nuclear Research Center Juelich) has been handling a project since 1983 on 'Further Development of the Borehole Technology for the Disposal of Radioactive Wastes in Salt, with the Examples of Dissolver Sludge, Fuel Element Claddings, Fuel Hardware und HTR Fuel Elements'. The project is sponsored by the Bundesminister fuer Forschung und Technologie, BMFT, (Federal Ministry of Research and Technology) under the identification number KWA 5302 3 and bears the short title 'MAW and HTR Fuel Element Test Disposal in Boreholes'. The major objective of the project is to develop a technique for the disposal of the above mentioned wastes in unlined boreholes in salt and to test this technique in the Asse salt mine. The Institut fuer Chemische Technologie der Nuklearen Entsorgung, ICT (Institute of Chemical Technology) at the KFA is responsible for the scientific and organizational management of the project. The Institut fuer Tieflagerung, IfT, (Institute for Underground Disposal) of the Gesellschaft fuer Strahlen- und Umweltforschung mbH, GSF, (Society for Radiological and Environmental Research) is responsible for the geomechanical and mining activities in the project. It supervises the in-situ experiments, and as the owner of the Asse salt mine, it submits applications for the experiments to the licensing authorities. Geomechanical calculations are being carried out by the Bundesanstalt fuer Geowissenschaften und Rohstoffe, BGR, (Federal Institute for Geological Sciences and Natural Resources).

237 (Juel-Conf—60, pp 1-13) **Boundary conditions, targets and organisation of the project on MAW and HTR fuel element test disposal in boreholes.** Bruecher, H. Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

This is a report on the organisation of the development of the technique of final storage of solidified sewage sludge, fuel element cans, structural parts and HTR fuel elements in tubed boreholes in salt. A first part of the project refers to the disposal and borehole closure technique and a second part refers to a recovery storage experiment.

238 (Juel-Conf—60, pp 15-29) **Storage and borehole closure technique.** Barnert, E. Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

Simulated MAW 400 l waste barrels were tested in the context of an in situ experment at the Asse salt mine, with the purpose of use on a large technical scale at the Gorleben final store. The filling of the borehole provided for final storage is done by a specially designed storage machine. In stacking the waste barrels, it is intended to divert the stacking forces to the borehole wall and 2 possibilities for this are discussed. For the stopper closing the borehole in the upward direction (10 meters high to the same floor), 2 variants were also developed. It consists at least partly of fine salt, which is also used to fill the annular gap.

239 (Juel-Conf—60, pp 31-53) **Characterisation of the MAW and HTR fuel element waste barrels for the recoverable storage experiment.** Kroth, K. Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

Waste barrels with cemented sewage sludge, fuel element cans, fuel element structural materials, i.e. with radioactive waste generating heat and dry store chambers with used AVR pellet fuel elements are characterized regarding their activity inventory, their {gamma}-dose rate and their nuclear heat ouput and are compared with the predictions of the ORIGEN activation calculations. They are provided for the experimental disposal program in the Asse salt mine.

240 (Juel-Conf—60, pp 55-68) **Test rig for measuring volatile radionuclides and radiolysis gases.** Goetze, H.G. (Wissenschaftlich-Technische Ingenieurberatung G.m.b.H., Titz-Roedingen (Germany, F.R.)). Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

In principle, the test rig consists of 6 measuring containers, each of which accommodates a drum with cemented waste. The measuring containers are piped, so that each forms a closed independent system, to the gas space of which a gas analysis equipment can be connected via a set of valves. The measuring container is equipped with controlled electrical heating for gas release measurements at high temperatures (max. 90/sup 0/C in the centre of the cemented waste).

241 (Juel-Conf—60, pp 69-82) **Investigations of the release of volatile radionuclides and radiolysis gases. First results.** Kroth, K. Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

A program of measurements accompanying the project for the relase of volatile radionuclides or of radiolysis hydrogen was developed for the safety-related assessment of the MAW storage technique in the Asse salt mine. The barrels provided for final storage with the cemented MAW were tested in the hot cell and the released gases were analysed.

242 (Juel-Conf—60, pp 83-98) **Radiolysis gas production in homogeneous cemented feed sewage sludge.** Offermann, P. (Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.)). Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

It is shown which factors play a part in estimating the formation of radiolytic hydrogen in a 400 litre waste barrel with cemented sewage sludge. The basic radiation chemistry reactions, dependence on the chemical composition, type of radiation and dose rate and the importance of radical catchers in the form of additives are discussed.

243 (Juel-Conf—60, pp 99-101) **Preliminary findings of special 1:200 and 1:100 geotechnical maps in the outcrop of the MAW field of the KFA Juelich at the 800 m level of Asse final storage facility near Remlingen, SE Niedersachsen.** Bottke, H.; Olfers, M. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Geologie und Palaeontologie). Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

244 (Juel-Conf—60, pp 103-114) **Design calculations for MAW storage experiment in the Asse salt mine.** Nipp, H.K. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

Several thermal pre-calculations examine what heat release is necessary in the storage experiment in order to produce a temperature level relevant to final storage at the edge of the borehole. It was found that the initial power must be 350-400 W/m. The thermo-mechanical design calculations are done on symmetrical equivalent models, in order to avoid a genuine spatial calculation. The results of the calculations show that the recovery of the radioactive waste is guaranteed over the whole experimental period, as the selected convergence space of 11 or 14 cm is sufficiently large. From the rock mechanics point of view, the MAW storage experiment is designed for the 800 m seam of the Asse mine, as no critical stresses are expected from calculations for the area of the borehole.

245 (Juel-Conf—60, pp 115-134) **Geo-technical investigations in the MAW storage experiment area of the Asse salt mine.** Schmidt, M.W.; Wieczorek, K.; Meyer, T. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

The natural stress and deformation behaviour within the Asse 2 salt mine has been considerably changed due to the mining work in the area of the existing pit building started more than 75 years ago. Rock mechanics model calculations clearly show that one can expect a secondary stress field even relatively far from existing mining chambers. The aim of the geotechnical investigations is to guarantee the recovery of the barrels from the rock mechanics point of view and to provide a sufficient basis for a rock mechanics analysis for the final storage technique - storage of MAW barrels in boreholes. The first step for measuring deformation due to starting the experimental field can be described as successful. The instrumentation of the remaining measuring cross section is expected in the year 1987.

246 (Juel-Conf—60, pp 135-159) **Machine technology, handling and preparation of borehole in recoverable storage experiment.** Niephaus, D. Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

The main point of this lecture is the introduction of the machine and handling technology and the borehole equipment. Due to the given boundary conditions, particularly that of recovery, the technical concept is not typical for final storage. The MAW barrel storage is introduced first, then the components necessary for AVR can storage and finally the main borehole equipment.

247 (Juel-Conf—60, pp 161-172) **Measuring and processing measured data in the MAW and HTR fuel element storage experiment. Pt. 1. Data acquisition by means of data loggers.** Kroth, K. Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

Until a central data collection plant is installed, a plant based on two identical data loggers is temporarily installed to measure the data obtained from the MAW experimental storage in the Asse salt mine from geomechanical and borehole measurements. This basic stage and the planned final stage are described.

248 (Juel-Conf—60, pp 173-186) **Measuring and processing measured data in the MAW and HTR fuel element storage experiment. Pt. 2. Central components of data acquisition in the Asse salt mine.** Henze, R. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

The central data collection plant for the MAW experimental storage in the Asse salt mine consists of 3 components: a) Front end computers assigned to the experiment for data collection, with few and simple components for the difficult ambient conditions underground. b) An overground central computer, which carries out the tasks of intermediate data storage, display at site, monitoring of the experiment, alarms and remote data transmission for final evaluation. c) A local network connects the front end computers to the central computer. It should take over network tasks (data transmission reports) from the front end computers and should make a flexible implementation of new experiments possible.

249 (Juel-Conf—60, pp 187-200) **Core material monitoring for recoverable storage experiment of used AVR fuel elements.** Buttler, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz). Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

In connection with the work to prove the disposal of the HTR waste, the KFA carried out an in situ storage experiment with used fuel elements from the AVR experimental power station. The experiment is taking place in the context of a storage experiment with MAW generating heat from the LWR reprocessing in the Asse salt mine of the Society for Radiation and Environmental Research (GSF). The following are introduced: the safety-related experimental conditions are described, the specific monitoring principles for the experiment are discussed, and two monitorig proposals (one each from Euratom and from the German side) are introduced.

250 (Juel-Conf—60, pp 201-219) **Rock mechanics measurements in the AVR section of the Asse salt mine.** Kreutz, F. Jul 1987. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755181/JAW. (CONF-8612164—).

From 1. status report on MAW and HTR fuel element test disposal in poreholes; Juelich, F.R. Germany (10 Dec 1986).

Measuring equipment for measuring rock mechanics parameters and the heat input (simulation of heat generated on the waste barrels) are tested and optimized for the experimental program for storing MAW and HTR fuel elements in the ASSE salt mine. The following measured parameters are included: Geometry of storage bores, course, ovality, convergence of storage bores with and without heat input, stresses in rock and temperature propagation for heat input in a borehole. The individual measuring equipments are described.

251 **(KFK—4426) Corrosion behaviour of selected high-level waste packaging materials under gamma irradiation and in-situ disposal conditions in rock salt.** Smailos, E.; Schwarzkopf, W.; Koester, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Entsorgungstechnik). Jul 1988. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755186/JAW.

Corrosion studies performed until now on a number of materials have shown that unalloyed steels, Hastelloy C4 and Ti 99.8-Pd are the most promising materials for a long-term resistant packaging to be used in high-level waste (HLW) canister disposal in rock salt formations. To characterize their corrosion behaviour in more detail, additional studies have been performed. The influence has been examined which is exerted by the gamma dose rate (1 Gy/h to 100 Gy/h) on the corrosion of three preselected steels and Hastelloy C4 at 90/sup 0/C in a salt brine (Q-brine) rich in MgCl/sub 2/, i.e., conditions relevant to accident scenarios in a repository. In addition, in-situ corrosion experiments have been carried out in the Asse salt mine at elevated temperatures (120/sup 0/C to 210/sup 0/C) in the absence and in the presence of a gamma radiation field of 3 x 10/sup 2/ Gy/h, within the framework of the German/US Brine Migration Test. Under the test conditions the gamma radiation did not exert a significant influence on the corrosion of the steels investigated, whereas Hastelloy C4, exposed to dose rates of 10 Gy/h and 100 Gy/h, underwent pitting and crevice corrosion (20 {mu}m/a at the maximum).The low amounts of migrated salt brine (140 ml after 900 days) in the in-situ- experiment did not produce noticeable corrosion of the materials.

252 **(NSS/R—113) Guide to the coupled chemical equilibria and migration code CHEQMATE.** Haworth, A.; Sharland, S.M.; Tasker, P.W.; Tweed, C.J. (UKAEA Harwell Lab. Theoretical Physics Div.). (United Kingdom Nirex, Ltd., Harwell). Feb 1988. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755444/JAW.

The CHEQMATE (CHemical EQuilibrium with Migration and Transport Equations) program has been developed to model the evolution of spatially inhomogeneous aqueous chemical systems. CHEQMATE models one-dimensional diffusion and electromigration of ionic species with chemical equilibration provided by the geochemical code PHREEQE. The transport and chemical parts of the CHEQMATE code are iteratively coupled, so that local chemical equilibrium is maintained as the transport processes evolve. CHEQMATE is very flexible and can easily be applied to many different evolving chemical systems. It has principally been used to study the evolution of the chemical environment in and around a nuclear waste repository.

253 **(NUKEM-FuE—85053) Disposal and solidification of LAW/MAW in underground caves. Phase 3. Reported period: July 1, 1982 - December 31, 1985. Final report.** Homann, H.H. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Sep 1986. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755190/JAW.

The waste metering and mixing plant above ground and the underground gravity-operated conveyor pipe line have been ready for operation since July 1984. Problems with the admixture of granular material induced new investigations to find a suitable substitute. Laboratory experiments on the flowability of various materials have been made in pipes and special viscometers and have shown silica sand with a grain size of 1.0-4.0 mm to have similar rheological properties. In agreement with the project management

and the BMFT, a first waste disposal campaign using silica sand as a substitute for the granulates has been scheduled for the autumn of 1984.

254 **(NUREG—1263) Hydrologic design for riprap on embankment slopes.** Codell, R.B. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Sep 1988. 80p. NTIS, PC A05/MF A01 - GPO. Order Number TI89001766/JAW.

Waste impoundments for uranium tailings and other hazardous substances are often protected by compacted earth and clay, covered with a layer of loose rock (riprap). The report outlines procedures that could be followed to design riprap to withstand forces caused by runoff resulting from extreme rainfall directly on the embankment. The Probable Maximum Precipitation for very small areas is developed from considerations of severe storms of short duration at mid-latitudes. A two-dimensional finite difference model is then used to calculate the runoff from severe rainfall events. The procedure takes into account flow both beneath and above the rock layer and approximates the concentration in flow which could be caused by a non-level or slumped embankment. The sensitivity to various assumptions, such as the shape and size of the rock, the thickness of the layer, and the shape of the embankment, suggests that peak runoff from an armored slope could be attenuated with proper design. Frictional relationships for complex flow regimes are developed on the basis of flow through rock-filled dams and in mountain streams. These relationships are tested against experimental data collected in laboratory flumes; the tests provide excellent results. The resulting runoff is then used in either the Stephenson or safety factor method to find the stable rock diameter. The rock sizes determined by this procedure for a given flow have been compared with data on the failure of rock layers in experimental flumes, again with excellent results. Computer programs are included for implementing the method. 15 refs., 21 figs., 9 tabs.

255 **(NUREG/CR—4651-Vol.2) Development of riprap design criteria by riprap testing in flumes: Phase II, Followup investigations.** Abt, S.R.; Wittler, R.J.; Ruff, J.F.; LaGrone, D.L.; Khattak, M.S.; Nelson, J.D.; Hinkle, N.E.; Lee, D.W. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning; Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 107p. (ORNL/TM—10100/V2). NTIS, PC A06/MF A01 - GPO. Order Number TI88017328/JAW.

Flume studies were conducted in which riprap embankments were subjected to overtopping flows. Embankments slopes of 1, 2, 8, 10, and 20% were protected with riprap containing median stone sizes of 1, 2, 4, 5, and/or 6 in. Riprap layer thickness ranged from 1.5 D_{50} to 4 D_{50}. Riprap design criteria for overtopping flows were developed in terms of unit discharge at failure, interstitial velocities and discharges through the riprap layer thickness and gradation on riprap stability, and potential impacts of integrating soil into the riprap layer for riprap stabilization. A riprap design procedure is presented for overtopping flow conditions.

256 **(PB—88-241252/XAB) Proposed low-level radioactive-waste standards: draft background information document, March 13, 1985. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 28 Oct 1985. 94p. (SAB/RAC—86/002). NTIS, PC A05/MF A01.

The Radiation Advisory Committee of the Science Advisory Board reviewed the EPA's March 13, 1985 draft Background Information Document to accompany the Agency's proposed standards on low-level radioactive-waste disposal. The Committee addressed eleven issues associated with the draft document. The Radiation Advisory Committee believes that the Background Information Document, on the whole, provides a reasonable presentation of the potential sources and risks associated with the disposal of low-level radioactive wastes. There are, however, deficiencies in parts of the document. To remedy these, the Committee has suggested extensive revisions, which should be made before publication of the Background Information Document.

257 **(PNL—6320-4) LFCM vitrification technology: Quarterly progress report, July-September 1987.** Brouns, R.A.; Allen, C.R.; Powell, J.A. (comps.); Bates, S.O.; Bray, L.A.; Budden, M.J.; Dierks, R.D.; Elliott, M.L.; Elmore, M.R.; Faletti, D.W.; Farnsworth, R.K.; Holton, L.K. Jr.; Kuhn, W.L.; Mellinger, G.B.; Nakaoka, R.K.; Peterson, M.E.; Piepel, G.F.; Powell, J.A.; Pulsipher, B.A.; Reimus, M.A.H.; Surma, J.E.; Wiemers, K.D. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 97p. NTIS, PC A05/MF A01. Order Number DE89002080/JAW.

This report describes the progress in developing, testing, applying and documenting liquid-fed ceramic melter vitrification technology. Progress in the following technical subject areas during the fourth quarter of FY 1987 is discussed: melting process chemistry and glass development, feed preparation and transfer systems, canister filling and handling systems, and process/product modeling and control.

258 **(PNL-SA—14665) Electropolishing decontamination system for high-level waste canisters.** Larson, D.E.; Berger, D.N.; Allen, R.P.; Bryan, G.H.; Place, B.G. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 8p. (CONF-870306—77). NTIS, PC A02. Order Number DE89001516/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

As part of a US Department of Energy (DOE) project agreement with the Federal Ministry for Research & Technology (BMFT) in the Federal Republic of Germany (FRG). The Nuclear Waste Treatment Program at the Pacific Northwest Laboratory (PNL) is preparing 30 radioactive canisters containing borosilicate glass for use in high-level waste repository related tests at the Asse Salt Mine. After filling, the canisters will be welded closed and decontaminated in preparation for shipping to the FRG. Electropolishing was selected as the primary decontamination approach, and an electropolishing system with associated canister inspection equipment has been designed and fabricated for installation in a large hot cell. This remote electropolishing system, which is currently undergoing preliminary testing, is described in this report. 3 refs., 3 figs., 1 tab.

259 **(PNL-SA—15343) Spent fuel metal storage cask performance testing and future spent fuel concrete module performance testing.** McKinnon, M.A.; Creer, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 7p. (CONF-8804145—1). NTIS, PC A02/MF A01. Order Number DE89001711/JAW.

From Joint ASME-ANS nuclear power conference; Myrtle Beach, SC, USA (17 Apr 1988).

REA-2023 Gesellshaft fur Nuklear Service (GNS) CASTOR-V/21, Transnuclear TN-24P, and Westinghouse MC-10 metal storage casks, have been performance tested under the guidance of the Pacific Northwest Laboratory to determine their thermal and shielding performance. The REA-2023 cask was tested under Department of Energy (DOE) sponsorship at General Electric's facilities in Morris, Illinois, using BWR spent fuel from the Cooper Reactor. The other three casks were tested under a cooperative agreement between Virginia Power Company and DOE at the Idaho National Engineering Laboratory (INEL) by EG&G Idaho, Inc., using intact spent PWR fuel from the Surry reactors. The Electric Power Research Institute (EPRI) made contributions to both programs. A summary of the various cask designs and the results of the performance tests is presented. The cask designs include: solid and liquid neutron shields; lead, steel, and nodular cast iron gamma shields; stainless steel, aluminum, and copper baskets; and borated materials for criticality control. 4 refs., 8 figs., 6 tabs.

260 **(PNL-SA—15558) Potential benefits of semiautomated, synoptic geologic studies for characterization of hazardous waste sites.** Foley, M.G. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 5p. (CONF-880903—41). NTIS, PC A02/MF A01. Order Number DE89001746/JAW.

From Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA (11 Sep 1988).

Pacific Northwest Laboratory (PNL) has developed a technology called remote geologic analysis (RGA). This technology provides reproducible photogeologic maps, determinations of three-dimensional faults and fracture sets expressed as erosional lineaments or planar topographic features, planar feature identification in seismic hypocenter data, and crustal-stress/ tectonic analyses. Results from the RGA establish a foundation for interpretations that are defensible in licensing proceedings. Field, laboratory, and analytical studies, which establish the validity of the remote, synoptic analyses, can then be identified and documented to provide needed administrative and litigative credibility. Further, these studies, when conducted early in a siting analysis, provide added direction and focus to siting activities. 5 refs., 4 figs.

261 **(PNL-SA—15624) Performance assessment for spent fuel waste packages at the candidate Nevada repository site.** Reimus, P.W.; Liebetrau, A.M.; Apted, M.J.; Engel, D.W. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 6p. (CONF-880903—36). NTIS, PC A02/MF A01. Order Number DE89001513/JAW.

From Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA (11 Sep 1988).

The Analytical REpository Source-Term (AREST) code is being developed for the US Department of Energy (DOE) as a preliminary performance assessment tool for evaluating waste package behavior in various geologic repository settings. In response to the 1987 amendments to the Nuclear Waste Policy Act of 1982, the code is being enhanced to provide specific assessments of being enhanced to provide specific assessments of waste package performance in the hydrologically unsaturated welded tuff geology of the candidate repository site at Yucca Mountain, Nevada. Modifications to the code are being made in each of three major functional areas: near-field environment modeling, waste package containment modeling, and waste package release modeling. This paper focuses specifically on the third of these, enhancements to radionuclide release modeling for spent fuel waste packages. 7 refs., 1 fig.

262 **(PNL-SA—15729) Pilot-scale grout production using a simulated low-level waste: Process description and product characterization.** Lokken, R.O.; Mitchell, D.H. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 7p. (CONF-880903—38). NTIS, PC A02/MF A01. Order Number DE89001703/JAW.

From Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA (11 Sep 1988).

A US Department of Energy (DOE) program is under way at the Hanford Site Richland, Washington, to convert the low-level fraction of selected liquid radioactive wastes to a cementitious grout form for near-surface disposal. Grout slurry, consisting of a mixture of liquid waste and a solids blend, will be pumped to near-surface disposal vaults where it will harden, thereby immobilizing the waste. A pilot-scale test was conducted in July 1986 to assess the effectiveness of the grouting operations and to characterize grout produced with pilot-scale equipment and disposed of in a monolithic form. The objectives of the pilot-scale test were to determine the homogeneity of the grout produced under conditions similar to those planned for the GTF, to evaluate performance of candidate grout processing equipment for the GTF, and to evaluate properties of grout produced during continuous operation over an extended time period and cured in a large monolith. The first waste stream to be processed in the GTF is called Phosphate/Sulfate Waste (PSW). The phosphate waste is from decontamination of the cooling system at N Reactor using a commercial solution containing phosphoric acid as the principal ingredient. The sulfate waste was produced during regeneration of ion-exchange resins with sulfuric acid. Each of these wastes are neutralized with sodium hydroxide, resulting in an aqueous waste containing sodium phosphate and sodium sulfate.

263 **(PNL-SA—15865) In situ vitrification: A candidate for immobilization and destruction of low-level, transuranic, and chemically contaminated soils.** Buelt, J.L.; Timmerman, C.L.; */estsik, J.H. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 32p. (CONF-8806116—4). NTIS, PC A03/MF A01. Order Number DE89001511/JAW.

From French bilateral symposium on accident exercises and experiences; Tours, France (20 Jun 1988).

In Situ Vitrification (ISV) is an emerging process that, through numerous development tests, has proven its applicability to a wide variety of radioactively and chemically contaminated soils. The first large scale radioactive test of this process has been completed, and preliminary results are summarized in this report. The ISV process melts contaminated soils in place, immobilizing radionuclides and heavy metals and destroying organics by pyrolysis. This report provides a summary of the process and its operational behavior, projected costs, and applications. 10 refs., 10 figs., 3 tabs.

264 **(PNL-SA—15922) Overview of a comprehensive environmental monitoring and surveillance program: The role of fish and wildlife.** Gray, R.H. (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 11p. (CONF-8810204—1). NTIS, PC A03/MF A01. Order Number DE89000579/JAW.

From American Fisheries Society annual meeting; Albuquerque, NM, USA (13 Oct 1988).

Concern about the effects of potential releases from nuclear and non-nuclear activities on the US Department of Energy's Hanford Site in southeastern Washington has evolved over four decades into a comprehensive environmental monitoring and surveillance program. The program includes field sampling, and chemical and physical analyses of air, surface and ground water, fish and wildlife, soil, foodstuffs, and natural vegetation. In addition to monitoring radioactivity in fish and wildlife, population numbers of key species are determined, usually during the breeding season. Data from monitoring efforts are used to assess the environmental impacts of Hanford operations and calculate the overall radiological dose to humans onsite, at the Site perimeter, or residing in nearby communities. Chinook salmon spawning in the Columbia River at Hanford has increased in recent years with a concomitant increase in winter nesting activity of bald eagles (Haliaeetus leucocephalus). An elk (Cervus elaphus) herd, established by immigration in 1972, is also increasing. Nesting Canada goose (Branta canadensis) and great blue heron (Ardea herodias), and various other animals, e.g., mule deer (Odocoileus hemionus) and coyotes (Canis latrans) are common. Measured exposure to penetrating radiation and calculated radiation doses to the public are well below applicable regulatory limits.

265 **(PNL-SA—15962) Development and design application of cerium (IV) decontamination process.** Bray, L.A.; Seay, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 3p. (CONF-880903—37). NTIS, PC A02. Order Number DE89001704/JAW.

From Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA (11 Sep 1988).

A simple and effective method was developed for decontamination of high-level waste canisters. This method of chemical decontamination is applicable to a wide variety of contaminated equipment found in the nuclear industry. Conceptual design of the cerium [Ce(IV)] decontamination process equipment has been completed for the West Valley Demonstration Project (WVDP) vitrification facility. This remote equipment, which is the first engineering scale application of this technology, will remove surface contamination from stainless-steel (SS) containers containing high-level waste (HLW) glass prior to placing them into temporary storage and ultimate shipment to a US Department of Energy (DOE) repository for disposal. The objective of the development and design study was to identify an effective chemical process and to design equipment to decontaminate the HLW glass canisters to limits that meet USDOE requirements. The equipment includes canister-capping and smear stations in addition to the decontamination module and associated services. 2 refs., 1 fig.

266 **(PNL-SA—16068) Plant rhizosphere processes influencing the mobility of radionuclides in soils.** Cowan, C.E.; Cataldo, D.A.; McFadden, K.M.; Garland, T.R.; Wildung, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1988. Contract AC06-76RL01830. 9p. (CONF-8809169—1). NTIS, PC A02/MF A01. Order Number DE89000578/JAW.

From International conference on chemicals (heavy metals) in the environment; Lisbon, Portugal (6 Sep 1988).

Native vegetation associated with commercial low-level waste disposal sites has the potential for modifying the soil chemical environment over the long term and, consequently, affecting radionuclide mobility. These changes were assessed for coniferous and deciduous trees grown in lysimeter systems by examining their influence on soil solution chemistry using advanced analytical and geochemical modeling techniques. Our studies demonstrated the formation of highly mobile anionic radionuclide complexes with amino acids, peptides and organic acids originating from plant leaf litter and roots. The production of complexing agents was related to season and tree species, suggesting that vegetation management or exclusion may be appropriate after a site is closed.

267 **(SAND—88-2022C) Technical operations and data collection details of the in situ WIPP [Waste Isolation Pilot Plant] Materials Interface Interaction Test.** Molecke, M.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-881089—1). NTIS, PC A03/MF A01. Order Number DE89001184/JAW.

From Alternatives to commercial cogeneration; San Diego, CA, USA (19 Oct 1988).

The WIPP Materials Interface Interaction Tests (MIIT) experiments involve the in situ testing of multiple "pineapple-slice" shaped samples of simulated (nonradioactive) waste glasses, potential canister and overpack metals, brine, and rock salt in the salt repository environment at WIPP. This series of experiments involves multiple emplacements of various US and foreign glass waste forms (all nonradioactive) in contact with/interacting with several container metals, rock salt, brine, etc., all maintained at approximately 90 {+-} 5{degree}C. The focus of this paper is on the technical aspects and operations of the MIIT experimental program, including assorted repository-relevant observations and experience gathered after more than two years of in situ test operation. As such, this is primarily a descriptive "hardware" and test operations document; test data are presented in parallel documents. 12 refs., 1 fig.

268 **(SKB-TR—87-11) Modelling of crustal rock mechanics for radioactive waste storage in Fennoscandia - problem definition.** Stephansson, O. (Luleaa Univ. (Sweden)). (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Luleaa Univ. (Sweden)). May 1987. 86p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755433/JAW.

Existing knowledge of crustal stresses for Fennoscandia is presented. Generic, two-dimensional models are proposed for vertical and planar sections of a traverse having a direction NW-SE in Northern Fennoscandia. The proposed traverse will include the major neotectonic structures at Lansjaerv and Paervie, respectively, and also the study site for storage of spent nuclear fuel at Kamlunge. The influence of glaciation, deglaciation, glacial rebound on crustal rock mechanics and stability is studied for the modelling work. Global models, with a length of roughly 100 km, will increase our over all understanding of the change in stresses and deformations. These can provide boundary conditions for regional and near-field models. Properties of strength and stiffness of intact granitic rock masses, faults and joints are considered in the modelling of the crustal rock mechanics for any of the three models described.

269 **(SKI—86058) Evaluation of hydrogen production from CO/sub 2/ corrosion of steel drums in SFR, Part 2.** Dugstad, A.; Videm, K. (Swedish Nuclear Power Inspectorate, Stockholm; Institute for Energy Technology, Kjeller (Norway)). Jun 1987. 27p. (IFE-KR-F—87-046). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755132/JAW.

An experimental program has been carried out for the investigation of the hydrogen formation due to corrosion of steel by water containing CO/sub 2/ produced by microbiologic decomposition of paper in waste drums. The hydrogen production will be limited by a limited rate of CO/sub 2/ production, as CO/sub 2/ is consumed by corrosive reactions producing carbonate containing corrosion products. Experiments indicated that also iron oxide and hydroxides were formed together with FeCO/sub 3/ at low CO/sub 2/ partial pressures but at a rate which leads to a rather slow increase in hydrogen production. Hydrogen evaluation has been overestimated in previous reports on this subject. (authors).

270 **(STRIPA-TR—86-04) In situ experiments in granite for the underground disposal of radioative wastes. Executive summary of phase 1.** (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jul 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755434/JAW.

The first phase of the Stripa Project concerned the development of methods and techniques or repository site investigations as well as verification of previosly obtained laboratory results by in situ experiments. The hydrogeological and hydrogeochemical investigations resulted in a recommendation on hydraulic testing at repository depth and the conclusion that detailed hydrogeochemical processes cannot be understood without the integrated use of several investigation techniques. Increased knowledge on the detailed flow of water and migration of nuclides in single fractures have strengthend our confidence in predicted retardation. The diffusion of the radionuclides into the rock matrix and sorption onto fracture surfaces have proven to be active in situ processes. The major conclusion from the investigation of bentonite as a buffer and backfilling material is that the main physical processes are understood and can be predicted for various repository geometries. The major process is water uptake from the rock since it governs the build-up of temperatures and swelling pressures. This uptake is primarily related to the water-bearing capacity of the surrounding rock and yields a fast maturation of the clay if the deposition holes are intersected by hydraulically active fractures. It was also concluded from the experiment that the techniques required for preparation and application of bentonite-based buffer materials are available.

271 **(UCID—21498) Testing and correction of underground tanks at LLNL: Report on 1988 activities and 1989 workplan.** Henry, R.K.; Peeters, L.A.; Schwartz, W.W.; Castro, D.J. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 117p. NTIS, PC A06. Order Number DE89001860/JAW.

This technical report documents corrective work completed on all underground tank systems that are leaking and on all underground tank systems for which leak tightness tests were inconclusive. The systems addressed by this report include all those identified in {ital Testing and Correction of Underground Tanks at LLNL, Workplan and Schedule} (Henry, 1987), as well as all other underground tank systems that have recently been found to leak. The LLNL Leak Tightness Testing Program is also described in this report. 4 refs., 2 figs.

272 **(WHC-EP—0063) Hanford radioactive solid waste packaging, storage, and disposal requirements.** Stickney, R.G. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1988. Contract AC06-87RL10930. 121p. NTIS, PC A06/MF A01. Order Number DE89001897/JAW.

Westinghouse Hanford Company manages and operates the Hanford Site 200 Area radioactive solid waste storage and disposal facilities for the US Department of Energy-Richland Operations Office under contract AC06-87RL10930. These facilities include radioactive solid waste disposal sites and radioactive solid waste storage areas. This manual defines the requirements that must be met by waste generators for radioactive solid waste to be accepted by Westinghouse Hanford Company for storage or disposal at the 200 Area facilities. It is to be used by all waste generators preparing radioactive solid waste for storage or disposal at the Hanford Site facilities. This manual is also intended for use by Westinghouse Hanford Company solid waste technical staff involved with ap-

proval and acceptance of radioactive solid waste. Requirements in the manual represent a compilation of state and federal regulations, US Department of Energy Orders, Hanford Site requirements, and other rules, regulations, guidelines, and standards as they apply to storage or disposal of radioactive solid waste. Where appropriate, these requirements are included in the manual by reference. It is the intent of this manual to provide guidance to the waste generator in meeting the applicable requirements. 20 refs.

273 **(WHC-EP—0096) Initial report on stress-corrosion-cracking experiments using Zircaloy-4 spent fuel cladding C-rings.** Smith, H.D. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1988. Contract AC06-87RL10930. 69p. NTIS, PC A04/MF A01. Order Number DE89000692/JAW.

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project is sponsoring C-ring stress corrosion cracking scoping experiments as a first step in evaluating the potential for stress corrosion cracking of spent fuel cladding in a potential tuff repository environment. The objective is to scope the approximate behavior so that more precise pressurized tube testing can be performed over an appropriate range of stress, without expanding the long-term effort needlessly. The experiment consists of stressing, by compression with a dead weight load, C-rings fabricated from spent fuel cladding exposed to an environment of Well J-13 water held at 90{degree}C. The results indicate that stress corrosion cracking occurs at the high stress levels employed in the experiments. The cladding C-rings, tested at 90% of the stress at which elastic behavior is obtained in these specimens, broke in 25 to 64 d when tested in water. This was about one third of the time required for control tests to break in air. This is apparently the first observation of stress corrosion under the test conditions of relatively low temperature, benign environment but very high stress. The 150 ksi test stress could be applied as a result of the particular specimen geometry. By comparison, the uniaxial tensile yield stress is about 100 to 120 ksi and the ultimate stress is about 150 ksi. When a general model that fits the high stress results is extrapolated to lower stress levels, it indicates that the C-rings in experiments now running at {approximately}80% of the yield strength should take 200 to 225 d to break. 21 refs., 24 figs., 5 tabs.

274 **(WHC-EP—0100) Properties and environmental impact of ammonia scrubber discharge waste to the 216-A-36B crib.** (Westinghouse Hanford Co., Richland, WA (USA)). Jan 1988. Contract AC06-87RL10930. 30p. NTIS, PC A03/MF A01. Order Number DE89002120/JAW.

Review of process flowsheets for potentially reportable waste components was conducted at the Hanford Site. The review indicated that the ammonia scrubber distillate (ASD) appeared to contain reportable quantities of the Class C toxin ammonium hydroxide (NH_4OH). Sampling and analysis of the ASD waste stream confirmed that reportable levels of NH_4OH were present. The Plutonium-Uranium Extraction (PUREX) processes that generated the waste to the 216-A-36B Crib were discontinued. The responsible regulatory agencies were notified on August 31, 1987. This report provides characterization data for evaluating the effect on the environment of the discharge of the ASD waste stream. Data provided include the concentration and quantity of NH_4OH discharged per hour during the maximum five hours of discharge. The total quantity of NH_4OH discharged per 29-h headend cycles and the estimated total quantities of NH_4OH and NH_4F discharged from 1966 to 1971 and 1983 to 1987 are provided. Numbers and dates of decladding cycles, volumes of discharges, and frequency of discharge are provided and combined with the NH_4OH discharge quantity per cycle to develop the total NH_4OH discharge values. Inorganic and organic waste parameter values are provided for two sampling dates. Average ammonium fluoride (NH_4F) concentration of 10 hourly sampling of the 10-h decladding cycle are provided.

275 **(WHC-EP—0137) Best Available Technology (economically achievable) guidance document for the Hanford Site.** (Westinghouse Hanford Co., Richland, WA (USA)). Jul 1988. Contract AC06-87RL10930. 41p. NTIS, PC A03/MF A01. Order Number DE89001895/JAW.

This document provides Westinghouse Hanford Company (Westinghouse Hanford) and the US Department of Energy (DOE) with a step-by-step procedure for the identification and documentation of the Best Available Technology (BAT) economically achievable for treating liquid effluents on the Hanford Site. The BAT determination is a key element in the DOE strategy to eliminate use of the soil column for contaminated effluents disposal. Following application of BAT, a liquid effluent is considered suitable for discharge to the environment, including the soil column. Liquid effluents on the Hanford Site are currently disposed of in accordance with DOE orders that require protection of public health and safety, and to the extent possible, minimize adverse impacts on the environment. The determination of BAT on a liquid effluent will only occur after the effluent meets all applicable release limits. As a result, the application of BAT may involve an additional level of control, as well as contribute to the overall Hanford Site as low as reasonably achievable (ALARA) program. 27 refs., 7 figs., 1 tab.

276 **(WHC-EP—0145) Westinghouse Hanford Company environmental surveillance annual report: 200/600 Areas, calendar year 1987.** Elder, R.E.; Egert, G.W.; Johnson, A.R.; Osborne, W.L. (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1988. Contract AC06-87RL10930. 132p. NTIS, PC A07/MF A01. Order Number DE89000348/JAW.

Near-field environmental surveillance of the Operations Area of the Hanford Site is performed by Westinghouse Hanford Company (Westinghouse Hanford) to assess and control the impacts of operations on the worker and the local environment. The results and conclusions of this program are presented in two reports: one for the 100 Areas and this report, covering the 200 and 600 Areas. Surveillance activities in the 200 and 600 Areas include sampling and analysis of ambient air, surface water, groundwater, sediments, soil, and biota. External radiation measurements and radiological surveys of waste disposal sites, radiological control areas, and roads are also performed. The 1987 data are summarized. 21 refs., 3 figs.

277 **(WHC-EP—0152) Results of ground-water monitoring for radionuclides in the Separations Area, 1987.** Serkowski, J.A.; Law, A.G.; Ammerman, J.J.; Schatz, A.L. (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1988. Contract AC06-87RL10930. 190p. NTIS, PC A09/MF A01. Order Number DE89001848/JAW.

The purpose of this report is to present a summary of the results for calendar year 1987 of the Westinghouse Hanford Company (Westinghouse Hanford) ground-water monitoring program for radiological constituents in the Separations Area of the Hanford Site. This monitoring program is implemented to partially fulfill the US Department of Energy (DOE) requirement that radioactivity in the environment be monitored. The program is also used to monitor operating disposal facilities for compliance with DOE requirements. The Separations Area radionuclide ground-water monitoring program is coordinated with other ground-water monitoring activities on the Hanford Site conducted by Westinghouse Hanford and Pacific Northwest Laboratory (PNL). The PNL program includes sampling for both radioactive and nonradioactive chemicals throughout the Site (including 100 and 300 Areas) and is responsible for estimating and evaluating the impact on ground water to the general public from all operations at the Hanford Site. Ground water characterization and monitoring for compliance with Resource Conservation and Recovery Act (RCRA) is also being conducted at facilities on the Hanford Site.

278 **(WHC-EP—0180) Hanford Environmental Management Program implementation plan.** (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1988. Contract AC06-87RL10930. 273p. NTIS, PC A12/MF A01. Order Number DE89002163/JAW.

The Hanford Environmental Management Program (HEMP) was established to facilitate compliance with the applicable environmental statues, regulations, and standards on the Hanford Site. The HEMP provides a structured approach to achieve environmental management objectives. The Hanford Environmental Management Program Plan (HEMP Plan) was prepared as a strategic level planning document to describe the program management, technical implementation, verification, and communications activities that guide the HEMP. Four basic program objectives are identified in the

HEMP Plan as follows: establish ongoing monitoring to ensure that Hanford Site operations comply with environmental requirements; attain regulatory compliance through the modification of activities; mitigate any environmental consequences; and minimize the environmental impacts of future operations at the Hanford Site. 2 refs., 24 figs., 27 tabs.

279 **(WHC-EP—0182-3) Tank farm surveillance and waste status summary report for June 1988.** Thurman, J.M. (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1988. Contract AC06-87RL10930. 28p. NTIS, PC A03/MF A01. Order Number TI89001884/JAW.

This report is Westinghouse Hanford Company's official inventory for high-level radioactive waste stored in underground tanks at the Hanford Site. Data that depict the status of stored high-level waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 underground waste tanks, as well as to provide supplemental information regarding tank equipment, tank anomalies, and ongoing investigations.

280 **(WHC-EP—0197) 1988 tank farm waste volume projections.** Strode, J.N.; Cruzen, T.L.; Riley, D.C.; Shaver, R.L. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1988. Contract AC06-87RL10930. 98p. NTIS, PC A05/MF A01. Order Number DE89002139/JAW.

This report projects the double-shell tank space requirements to the year 2015. This document is based on operational and waste generation assumptions developed from the major Hanford waste generating facilities. Suggestions are presented to alleviate potential tank space shortages. 28 figs., 11 tabs.

281 **(WHC-SA—0248) Hanford Defense Waste Management Program.** Lerch, R.E. (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1988. Contract AC06-87RL10930. 67p. NTIS, PC A04/MF A01. Order Number DE89001899/JAW.

This document contains only the viewgraphs from a speech on Hanford's radioactive waste management. (TEM)

282 **(WHC-SA—0316) Characterization of sediment in a leaching trench RCRA [Resource Conservation and Recovery Act] site.** Zimmerman, M.G.; Kossik, C.D. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1988. Contract AC06-87RL10930. 11p. (CONF-881054—27). NTIS, PC A03/MF A01. Order Number DE89001909/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

Hazardous materials potentially were disposed of into a pair of leaching trenches from 1975 until Resource Conservation and Recovery Act (RCRA) regulations were imposed in 1985. These leaching trenches now are used for disposal of nonhazardous process water. The typical effluent (approximately 3 million gal/d) consisted of water with trace quantities of laboratory, maintenance, and fuel fabrication process chemicals. The largest constituent in the waste stream was uranium in low concentrations. This paper describes the project used to analyze and characterize the sediments in and below the leaching trenches. The project results were that no measurable contamination was found in the deep sediments. Measurable contamination from metals, such as chromium and nickel, was found in the shallow sediments. The primary contaminant in the shallow sediments was uranium. The concentration of contaminants decreased rapidly to near-background levels at shallow depths below the bottoms of the trenches. 4 refs., 1 fig., 3 tabs.

283 **(WHC-SA—0381) System design, construction, and start-up of the Hanford Site Transportable Grout Equipment facility.** Carrigan, M.C.; Gaines, H.P. Jr. (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1988. Contract AC06-87RL10930. 4p. (CONF-880903—42). NTIS, PC A02/MF A01. Order Number DE89001914/JAW.

From Spectrum '88: international topical meeting on nuclear and hazardous waste management; Pasco, WA, USA (11 Sep 1988).

The US Department of Energy (DOE) and Westinghouse Hanford Company (Westinghouse Hanford) have developed a grouting process for the immobilization and final disposal of mixed low-level tank wastes from various Hanford N-Reactor operations. Associated Technologies, Inc. (ATI), now part of US Ecology Nuclear, was selected to design, construct, and start-up the Transportable Grout Equipment (TGE) facility with technical assistance from SGN of France.

284 **(WHC-SA—0407) Westinghouse Hanford Company waste minimization actions.** Greenhalgh, W.O. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1988. Contract AC06-87RL10930. 41p. (CONF-8809172—1). NTIS, PC A03. Order Number DE89001912/JAW.

From Waste minimization workshop; Richland, WA, USA (7 Sep 1988).

Companies that generate hazardous waste materials are now required by national regulations to establish a waste minimization program. Accordingly, in FY88 the Westinghouse Hanford Company formed a waste minimization team organization. The purpose of the team is to assist the company in its efforts to minimize the generation of waste, train personnel on waste minimization techniques, document successful waste minimization effects, track dollar savings realized, and to publicize and administer an employee incentive program. A number of significant actions have been successful, resulting in the savings of materials and dollars. The team itself has been successful in establishing some worthwhile minimization projects. This document briefly describes the waste minimization actions that have been successful to date. 2 refs., 26 figs., 3 tabs.

285 **Grout formulation for disposal of low-level and hazardous waste streams containing fluoride.** McDaniel, E.W.; Sams, T.L.; Tallent, O.K. US Patent Application 6-056,833. 2 Jun 1987. 16p. Contract AC05-84OT21400. NTIS, PC A03/MF A01.

A composition and related process for disposal of hazardous waste streams containing fluoride in cement-based materials is disclosed. the presence of fluoride in cement-based materials is disclosed. The presence of fluoride in waste materials acts as a set retarder and as a result, prevents cement-based grouts from setting. This problem is overcome by the present invention wherein calcium hydroxide is incorporated into the dry-solid portion of the grout mix. The calcium hydroxide renders the fluoride insoluble, allowing the grout to set up and immobilize all hazardous constituents of concern. 4 tabs.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 135, 136, 166, 168, 169, 170, 171, 206, 208, 210, 212, 214, 215, 216, 218, 219, 220, 222, 223, 257, 258, 259, 260, 261, 263, 265, 266, 271, 272, 273, 274, 276, 277, 278, 279, 282, 285

286 (CONF-870859—Pt.3, pp 27-47) **Environmental analysis of closure options for waste sites at the Savannah River Plant.** Gordon, D.E.; King, C.M.; Looney, B.B.; Stephenson, D.E.; Johnson, W.F. (E. I. du Pont de Nemours and Co., Aiken, SC (USA)). Feb 1988. NTIS, PC A09/MF A01. Order Number DE88013146/JAW. Contract AC09-76SR00001.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

To comply with the requirements of the National Environmental Policy Act, the Department of Energy has prepared an environmental impact statement (EIS) on the implementation of hazardous, low-level radioactive, and mixed (hazardous and radioactive) waste management activities for the protection of ground water, human health, and the environment at the Savannah River Plant. Waste management activities assessed in the EIS are: (1) implementation of remedial and closure actions at active and inactive hazardous, low-level radioactive, and mixed waste sites; (2) establishment of new on site waste disposal facilities for hazardous, low-level radioactive, and mixed wastes; and (3) discharge of disassembly basin purge water from C, K, and P reactors. Previously acceptable waste management practices (e.g., the use of unlined seepage basins) for discarding of wastes from nuclear materials production has resulted in occasional cases of ground water contamination beneath some disposal sites, mainly in water-table aquifers. Ground water contaminants include volatile organic compounds, heavy

metals, radionuclides, and other chemicals. An environmental analysis of the closure options for the criteria waste sites (those which have received hazardous and/or low-level radioactive wastes) was conducted to provide technical support for the EIS. The several parts of this environmental analysis include: (1) description of geohydrologic conditions; (2) determination of waste inventories; (3) definition of closure options; (4) modeling of environmental pathways; (5) assessment of risk; and (6) analysis of project costs. Each of these components of the overall analysis is described in turn in the following paragraphs. 15 references, 5 tables.

0540 Health And Safety

REFER ALSO TO CITATION(S) 134, 158, 162, 168, 176, 178, 182, 183, 184, 185, 186, 200, 203, 204, 205, 213, 214, 241

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 133

287 **(CONF-881054—20) Health and safety training for hazardous waste site activities at Oak Ridge National Laboratory: Implementation of OSHA 29 CFR 1910.120(e).** White, D.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A03/MF A01. Order Number DE89001701/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

The Technical Resources and Training Program has expended considerable effort in development of SARA/OSHA Training for Hazardous Waste Site Activities at ORNL. Much of the material developed for this training program, particularly the Basic 24-hour course, is generic in nature and could be easily incorporated into other facilities' programs. To provide these materials across the Department of Energy (DOE) system, the Training Resources and Data Exchange (TRADE) has worked with ORNL staff to publish materials used in the Basic Training for General Site Workers in a TRADE document[7]. This document is the first in a new line of TRADE resources designed to provide DOE and contractor training personnel with the tools needed to meet steadily increasing training requirements. Subsequent documents will include materials for supervisors/managers and remedial action workers. 7 refs.

288 **(FMPC—2162) Criticality alarm system design and operational experience at the Westinghouse Materials Company of Ohio.** Eversole, M.J.; Lindenschmidt, D.J. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 1988. Contract AC05-86OR21600. 8p. (CONF-8809144—6). NTIS, PC A02. Order Number DE89001541/JAW.

From DOE criticality alarm system workshop; Richland, WA, USA (20 Sep 1988).

The Feed Materials Production Center (FMPC) handles a wide variety of uranium materials ranging in enrichment from depleted to 19.99% U235. Due to the presence of enriched uranium materials onsite, a criticality alarm system is required. This paper describes past, present, and future criticality alarm system designs, as well as problems which have been encountered during design, installation, and operation of those systems.

289 **(IAEA-STR—243) Advisory group meeting on safeguards related to final disposal of nuclear material in waste and spent fuel. Secretariat working paper.** (International Atomic Energy Agency, Vienna (Austria). Dept of Safeguards). Jul 1988. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704479/JAW.

This paper is primarily concerned with Section 11 of INFCIRC/153 which provides for the possible termination of safeguards based on a determination that the nuclear material in question has been consumed, has been diluted, or has become practicably irrecoverable. Two distinctly different categories of nuclear material have been suggested for possible termination of safeguards based on a determination that the nuclear material has become practicably irrecoverable: One relates to a variety of low concentration waste materials, meaning thereby materials which the State or plant operator considers to be of questionable economic recoverability and the other relates to the spent fuel placed in facilities described as "permanent repositories" which are at least claimed to represent "final disposal" facilities and are candidates for a possible determination of practicably irrecoverable. 26 refs, tabs.

290 **(IAEA-STR—244) Design verification for large reprocessing plants (Proposed procedures).** Rolandi, G. (International Atomic Energy Agency, Vienna (Austria). Dept of Safeguards). Jul 1988. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704480/JAW.

In the 1990s, four large commercial reprocessing plants will progressively come into operation: If an effective and efficient safeguards system is to be applied to these large and complex plants, several important factors have to be considered. One of these factors, addressed in the present report, concerns plant design verification. Design verification provides an overall assurance on plant measurement data. To this end design verification, although limited to the safeguards aspects of the plant, must be a systematic activity, which starts during the design phase, continues during the construction phase and is particularly performed during the various steps of the plant's commissioning phase. The detailed procedures for design information verification on commercial reprocessing plants must be defined within the frame of the general provisions set forth in INFCIRC/153 for any type of safeguards related activities and specifically for design verification. The present report is intended as a preliminary contribution on a purely technical level, and focusses on the problems within the Agency. For the purpose of the present study the most complex case was assumed: i.e. a safeguards system based on conventional materials accountancy, accompanied both by special input and output verification and by some form of near-real-time accountancy involving in-process inventory taking, based on authenticated operator's measurement data. C/S measures are also foreseen, where necessary to supplement the accountancy data. A complete "design verification" strategy comprehends: informing the Agency of any changes in the plant system which are defined as "safeguards relevant"; "reverifying by the Agency upon receiving notice from the Operator on any changes, on "design information". 13 refs.

291 **(PB—88-868286/XAB) Terrorism. January 1970-September 1988 (Citations from the NTIS data base). Report for January 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 111p. NTIS PC N01/MF N01.

Supersedes PB—87-867461.

This bibliography contains citations concerning political, psychological, and sociological studies of international and domestic terrorism, including activities in the Middle East, Europe, and North and South America. Terrorism and countermeasures with respect to diplomacy, intelligence, law enforcement, military operations, and security systems are considered. Nuclear materials management regarding terrorist activities is also included. (This updated bibliography contains 188 citations, 21 of which are new entries to the previous edition.)

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 152, 153, 155, 156, 157, 158, 159, 161, 172, 187, 196, 210, 226, 1759

292 (CONF-870859—Pt.2, pp 39-50) **Guide to the Liability Risk Retention Act of 1986.** Merklein, E.A. (Alexander & Alexander, Inc., New York, NY (USA)). Feb 1988. NTIS, PC A05/MF A01. Order Number DE88013145/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The Liability Risk Retention Act of 1986 (LRRA) allows the formation of risk retention groups for the purpose of insuring all types of business liability. The major goal of the legislation was to facilitate alternatives to standard liability insurance for small businesses, non-profit organizations, local governments, and professionals whose insurance costs have skyrocketed over the past few years. Many of these entities are too small to self-insure, and state

regulations often limit or eliminate other pooling options. Recognizing this problem, Congress acted to make easier the formation of risk retention groups - that is, self-insurance pools for organizations with similar liability risks. This paper summarizes and explains the provisions of the newly enacted LRRA. The first section describes the characteristics of risk retention groups (RRGs) under federal law: who can be part of such groups and what activities can such groups carry out. The next section outlines the state regulations and laws that are preempted by the Act and those that are still permitted. Finally, the paper discusses a number of questions relating to the organization of RRGs for certain entities such as municipalities and pollution generators. It also discusses the provisions of the LRRA that deal with so-called purchasing groups.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 1844

293 (ACIESP—60-Vol.1, pp 64) **Enrichment measurements in a vacuum arc plasma centrifuge.** Del Bosco, E.; Dallaqua, R.S.; Ludwig, G.O. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

294 **(DP-MS—88-134) Planning and scheduling maintenance work in support of the SRP [Savannah River Plant] separations areas.** Boyce, D.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 26p. (CONF-8810174—5). NTIS, PC A03/MF A01. Order Number DE89001482/JAW.

From Plutonium/uranium recovery operations conference; Idaho Falls, ID, USA (4 Oct 1988).

The Savannah River Plant, operated by E.I. du Pont de Nemours and Co. for the United States Department of Energy, has successfully implemented a system for work control and planning in support of two separations areas. The Separations Works Engineering (SWE) Department is responsible for maintenance of the separations areas at the Savannah River Plant. The organization has 24 maintenance crews consisting of 215 mechanics. In March 1985 a Planning and Scheduling program was implemented within SWE. Several benefits were realized through the Planning and Scheduling system. The effectiveness of maintenance work increased 40% and the backlog of work has been reduced. The Planning and Scheduling organization is also responsible for reviewing work requests for approval authority.

295 **(INIS-BR—1287) 99Mo-99mT/sub c/ generator - study of their performance and quality.** Acar, M.E.D. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. 73p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704530/JAW.

In this work the performance of the /sup 99/Mo -/sup 99m/Tc generators produced at IPEN-CNEN/SP as well as the quality of the eluted solutions were analysed. The following parameters were studied: elution efficiency, chemical radiochemical, radionuclidic and microbiological purities and pH of the eluates. The/sup 99m/Tc yield ranged from 84,7 to 98,5%. The radioactivity due to the pertechnetate ion in the studied solutions was higher than 97,5%. The aluminium content in eluates, determined by spectrophotometry, was lower than 2,5 μg/ml and the pH of the solutions between 4,5 and 5,1. Radioactive impurities of the order of 10/sup -3/KBq/sup 99/Mc/MBq/sup 99m/Tc and 10/sup -5/KBq /sup 131/I/MBq/sup 99m/Tc were found in the eluates at the time of elution. Other γ emitting radioactive impurities were order of 10/sup -3/ KBq/MBq/sup 99m/Tc. The eluates were sterile and pyrogen-free. From the results obtained in this work one can state that the IPEN-TEC generator is a reliable source of good quality/sup 99m/Tc-pertechnetate.

296 **(PB—88-868641/XAB) Membrane gas separation. January 1970-September 1988 (Citations from the NTIS data base). Report for January 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 104p. NTIS PC N01/MF N01.

Supersedes PB—86-855152.

This bibliography contains citations concerning the research and development of gas separation and purification utilizing plastic and metal membranes. Among the topics included are isotope separation, osmotic techniques, reverse osmosis, and preparation of membranes for specific separation processes. The permeability of polymer membranes is discussed in terms of physical properties as well as molecular structure. The selectivity of polymeric films for a variety of gases is also included. (This updated bibliography contains 150 citations, 27 of which are new entries to the previous edition.)

0702 Radiation Sources

297 **(CONF-8810182—3) Design calculations for the ANS [Advanced Neutron Source] cold source.** Lillie, R.A.; Alsmiller, R.G. Jr. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01. Order Number DE89001196/JAW.

From International collaboration on advanced neutron sources; Los Alamos, NM, USA (3 Oct 1988).

The calculation procedure, based on discrete ordinates transport methods, that is being used to carry out design calculations for the Advanced Neutron Source cold source is described. Calculated results on the gain in cold neutron flux produced by a liquid deuterium cold source are compared with experimental data and with calculated data previously obtained by P. Ageron et al., at the Institute Max von Laue-Paul Langevin in Grenoble, France. Calculated results are also presented that indicated how the flux of cold neutrons vary with cold source parameters. 23 refs., 5 figs., 3 tabs.

298 (DOE/ER/60631—1, pp 87-90) **Preliminary designs of a soft-X-ray source based on proton bombardment of gaseous targets.** Randers-Pehrson, G. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

Currently the soft X rays used in their laboratory are generated by irradiating solid targets with electrons emitted from a hot filament. However, this system is severely limited for X rays other than Al (1487 eV) for a number of reasons. Preliminary experiments with carbon X rays (277 eV) suggest that, at a voltage sufficient to produce an adequate dose rate, the problem will be considerably worse. This is because the yield of ionizations will go down roughly with Z and the fluorescent yield will go down by about a factor of 20. In addition, the fluence of carbon X rays will suffer much more attenuation passing through the vacuum windows than the aluminum X rays. Therefore, in order to obtain an adequate dose rate, it would be necessary to either increase the intensity of the incident electrons or increasing the energy of the incident electrons to one much greater than the desired characteristic energy. This latter option would result in a significant Bremsstrahlung contamination, made worse by differential absorption of the desired characteristic X rays in the vacuum windows. Their preliminary experiments indicate that ~ 30% contamination by dose of higher-energy photons would be likely.

299 **(INIS-mf—11312) Application of radionuclide methods in metallurgy and engineering.** Chlobystina, E.; Strba, J. (eds.). (Ceskoslovenska Komise pro Atomovou Energii, Prague). 1987. 318p. (In Czech, Russian, Slovak). (CONF-8706308—). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW.

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

A total of 40 papers were presented at the conference, all of which fall in the INIS scope. Two fields were covered: 1. application of radionuclide methods in the solution of technological, production and quality problems of the manufacture of steel in converters, in ladle metallurgy and in continuous casting of steel and

non-ferrous metals on equipment of various design; 2. investigation of the homogeneity and microstructure parameters of alloys, and of corrosion processes using radionuclides. (Z.S.).

300 (INIS-mf—11312, pp 6-14) **Some new applications of beta backscattering in engineering and metallurgy.** Srents, A.; Petrov, A.; Balabanov, N. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Briefly described are methods and instruments using backscattering of beta particles for determination of the thickness of coatings and for checking the composition of two-component alloys or mixtures. A new application of the method is the determination of the thickness of the oil film on the surface of machine parts; the thickness significantly affects resistance to wear. (Z.S.). 6 figs., 1 tab., 10 refs.

301 (INIS-mf—11312, pp 15-20) **Current state of using radionuclides in mining and in metallurgy in the GDR.** Holzhey, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Data is presented characterizing the range of the industrial use of tracer and radiometric methods in mining and metallurgy in the GDR in the years 1957-1975 and 1985. Of radiometric methods the most widely used were level gages, densimeters and fire detectors. Level gages were most widely used for measuring the height of filling of hoppers and silos. Radionuclide analytical methods are mainly used in the potassium industry for determining the content of potassium oxide. Natural radiation of /sup 40/K radionuclides is used in the process. (Z.S.). 4 tabs., 2 refs.

302 (INIS-mf—11312, pp 21-26) **Probabilistic assessment of autoradiograms of solid metal alloy microstructure.** Radwan, M.; Gibas, K.; Narbuntowicz, E. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

A new method for studying the structure of alloys has been developed allowing to determine the forms of the probability distribution of the concentration of components. The new method proceeds from the fact that the metallographic structure of alloys is determined by the concentration of components occurring in different places throughout the alloy. The concentrations of components in alloys were obtained by autoradiography and by structural methods of studying metals. The method was verified on several models of autoradiograms of alloy structure. Data on the concentration of alloy components and the results of photometric analysis of model autoradiograms were used to determine (using computer technology) the form of the probability distribution of detecting the concentration of the investigated component in the given alloy. The computer programs written for this study allowed to obtain not only the initial identification of the probability distribution and its parameters but also to conduct verification tests of the agreement of empirical and theoretical distributions. Examples are given of the use of the method in studying the probability distribution of the concentration of components in selected alloys. (author). 11 refs.

303 (INIS-mf—11312, pp 27-33) **Radionuclides in metallurgical practice of steel-making plant I of VZSKG.** Brezina, J.; Hons, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Investigated was the dissolution of lump additives in the melt during steel deoxidation. The rate of additive dissolution and the moment of development of homogeneous melt were determined by tracer technique. The tracers applied in the detection included the radionuclides /sup 51/Cr, /sup 99/Mo, /sup 110/Ag, /sup 124/Sb, /sup 181/Hf, /sup 182/Ta and /sup 198/Au, with an activity of 0.8 GBq. (Z.S.). 6 figs., 2 tabs., 2 refs.

304 (INIS-mf—11312, pp 76-83) **Testing of wear in power plants.** Hartmann, G.; Kulicke, P. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The main causes of wear of steam generator parts are presented and methods are discussed of testing wear using radionuclide techniques. Special attention is centred on radioactive labelling of important parts of machine equipment, namely of their surfaces. The results are presented and discussed of wear testing in coal mills, in high pressure heat exchangers, high pressure valves, and of the optimization of the water cycle. (author). 8 figs.

305 (INIS-mf—11312, pp 84-96) **Spectrometric determination of radioactive tracers in metallurgical applications.** Mayer, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The tracer techniques have an important role in the study of technological processes in operating conditions of metallurgical enterprises. Radioactive samples of metallurgical materials are measured with the spectrometric system TN-4500 using two spectrometric chains. In case of multi-element labelling the complex mixture requires the use of gamma spectrometry for qualitative proof and quantitative determination of radionuclides. Multi-element labelling and the spectrometric method have been put to practical use in operating conditions of trial melts. The aim of the work is to contribute to improving the quality of metallurgical products and to the development of modern technologies. (author). 19 figs., 1 tab., 5 refs.

306 (INIS-mf—11312, pp 97-100) **Nuclear methods applied in Romania in determining wear of blast furnace refractory lining.** Staicu, L. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

At different points and in different depths of the refractory lining, radionuclides /sup 60/Co, /sup 110m/Ag, /sup 204/Tl are placed. With the wear of the lining the radioisotopes get into contact with the pig iron in which they dissolve. The loss of isotopes which indicates the wear of the lining is detected in two ways in dependence on their location. Isotopes from the furnace bottom are detected in pig iron and in the slag, isotopes from the walls of the hump of the shaft are detected by probes placed on the furnace casing. Also applicable are methods based on the photoneutron effect. Be or BeO targets in form of a plate are placed at pre-set points in the lining. The condition of the beryllium plates is monitored using gamma radiation and neutron detectors. When wear affects the plate, the plate will disintegrate and this will show by loss of the detector signal. (J.B.). 1 fig.

307 (INIS-mf—11312, pp 101-104) **Solubility of alloying additions in ladle.** Lonsky, B.; Hons, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The quality of alloy steels is characterized by the high homogeneity of chemical composition. The dissolution of alloying additions was studied using cubes (50 mm - 130 mm) of FeCr, FeMn, SiMn and FeTi labelled in their geometric centre with a suitable radionuclide. Steel samples were taken from the ladle, from the flow during casting and from billets. The presence and radioactivity of tracers were identified by gamma spectrometry. The use of the TN-4500 analyser allowed simultaneous investigation of several different alloying additions and bodies of different sizes during one melt. The method allows to determine the time needed for dissolving the alloying addition and for achieving homogenization and has been used in practice. A number of technological measures have been made with considerable economic benefit using the results of the method. (author). 3 figs., 1 tab.

308 (INIS-mf—11312, pp 105-108) **Radioactive tracer investigation of crystallization processes in cast ingots.** Rajcher, Kh.; Peneva, Ts.; Boyadzhiev, L. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Radiometric scanning was used and data processed by microcomputer to study the crystallization of metal during continuous iron casting. The method allows to obtain a spatial image of the liquid phase and thereby also information on the effect of various technological factors on the process of crystallization. (author). 3 figs., 6 refs.

309 (INIS-mf—11312, pp 109-115) **Radiometric testing of gassing in grey cast irons.** Peneva, Ts.V.; Boyadzhiev, L.Kh.; Rajchev, Kh.; Walis, L.S.; Kalicki, A. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

An instrument was selected for the quantitative determination of gassing using tracer techniques. The instrument was used to detect the effect of alloying additions, modifiers and metallurgical factors on the gassing of grey cast irons. Optimal conditions were set for the manufacture of cast alloys with maximum density. (author). 5 figs., 1 tab., 4 refs.

310 (INIS-mf—11312, pp 116-122) **Control of continuous steel casting using tracer techniques.** Hons, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

A /sup 60/Co granule enclosed in a casing of non-radioactive pure molybdenum is used as a point source. An ampule with cobalt is inserted in the centre of a casting of lead labelled with / sup 124/Sb in a steel casing. At the set moment the labelled body is thrown into the crystallizer and time recording of gamma radiation starts with a scintillation probe. Usually after 60 secs another source is thrown into the crystallizer, preferably /sup 110m/Ag encased in molybdenum only. The two measured points are recorded simultaneously on one graphic record. The surface of the glowing hot sow is visibly marked at the point of maximum recorded radiation for subsequent surface contact activity check and for marking the cutting areas for sample taking for laboratory testing. Peaks of the different radionuclides are identified using a Ge(Li) detector and a multi-channel analyzer by TRACOR. (J.B.). 2 figs., 4 tabs., 8 refs.

311 (INIS-mf—11312, pp 302-309) **Application of nuclear methods in steel-making operations of TZ VRSR.** Kisiel, B.; Adamec, V.; Komarek, P.; Pietro, S. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The use of radionuclides and nuclear methods at the Trinec iron works has a long tradition. In the early 1960's a radioisotope laboratory was established here for this purpose, which after ten years of work was transferred to the Research Institute of Iron Metallurgy at Dobra. The initial period was focused on the study of inclusions in steel of exogenous origin using the methods of radioactive and non-radioactive tracing. In recent years the operating applications of radionuclides were integrated in the research of the technology of steel production in an oxygen converter, this first within simulated experimental melts in open-hearth furnaces, later in the run-in operation of the oxygen converter steel works. The research was focused on the contamination of steel with coke dust, on alloying additions dissolution in the ladle, the dephosphorization process, the desulfurization process, etc. At present, nuclear methods are to be used for seeking the optimal technology of the production of steel of peak quality, prospectively also of continuous casting. (author). 4 tabs.

312 (INIS-mf—11312, pp 34-41) **Measurement of diffusion properties using radioisotope methods.** Cermak, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

A brief description is presented of the method of measuring diffusion characteristics of elements in solid metals and their alloys, based on the use of radioisotopes. (author). 4 figs., 13 refs.

313 (INIS-mf—11312, pp 42-49) **Radiotracer investigation of permanent air pollution distribution in Diesel engine.** Kras, J.; Slomka, J.; Zukowska-Cwik, G.; Walis, L. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The principle is presented of the tracer technique and the results are given of investigating the distribution of test samples of dust between oil (with the use of an oil filter) and exhaust gases; the dust is proportioned into the combustion space. The technical condition of the Diesel engine was found to play the main role in the distribution of the dust. (Z.S.). 3 figs., 2 tabs., 2 refs.

314 (INIS-mf—11312, pp 59-70) **Modelling and kryptonate method of studying wear of plastic-working machines.** Szili, S.; Varkonyi, A.; Molnar, I.; Jarecsni, Z.; Volk, J. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The wear of tools of different quality used for forming plastics with and without filler was investigated. The method applied was the radiotracer technique using /sup 85/Kr. As krypton losses from the surface occur not only owing to wear but also as a result of changes in temperature and of corrosion it was necessary to eliminate the said factors. Thermal effects were removed after kryptonation by heat treatment of the surface at a temperature of 250 degC for a period of 1 hour. Corrosion effects were assessed by laboratory tests. The degree of wear of tools was determined at temperatures of 205, 220 and 235 degC and pressures of 8, 16 and 20 MPa. (Z.S.). 8 figs., 1 tab., 3 refs.

315 (INIS-mf—11312, pp 123-135) **Radioisotope investigation of continuous steel casting.** Lehofer, K.; Szili, S. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The effects are discussed of the design of the casting set, the system of the coupling of spray water cooling and the movement inside the liquid zone, on hardening, the macrostructure of ingots, the macrodistribution of non-metallic inclusions and the formation of surface cracks in cast ingots. It is demonstrated that with the use of a casting funnel with side openings and a system of support cylinders, with a total change in the system of cooling jets of the sprayer and after attaining continuous film boil in the spray tube of the water cooler, the output of the casting set may be increased by 50%, this with substantially improved quality of castings. (J.B.). 9 figs., 7 refs.

316 (INIS-mf—11312, pp 136-141) **Radiometric tracing of dross and aluminium oxide in rimmed steel ingots.** Kraina, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The reduction of mechanical properties of rimmed steels may be caused by the local increase in the content of non-metallic impurities generated in the process of casting accompanied by forced interruption of the cast-iron mould boil. The contamination of rimmed steel with dross was studied by radioactive labelling of the dross with /sup 141/Ce in form of oxide and /sup 46/Sc as the

Al-Sc alloy. The radioactive tracers were added to the steel surface and the ingots were mechanically covered. The results of operating trials proved unambiguously that dross penetrated from the surface to the ingot body, the highest impurity levels were found in the neighbourhood of the head and heal of the ingot and along the longitudinal axis of the rolled sections. (author). 2 figs., 2 tabs., 3 refs.

317 (INIS-mf—11312, pp 142-147) **Study of phosphorus removal from steel in oxygen converter.** Mrazek, L. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The process of dephosphorization was studied using radionuclide /sup 32/P obtained by the irradiation of ferrophosphorus in a nuclear reactor. The labelling material was dissolved in pig iron prior to casting in the converter. In the process of melting steel, slag and stack flue ash, were sampled, in the process of homogenization and steel casting, samples of slag and steel were taken. The results of trial castings confirmed the high level of dephosphorization of steel in the converter especially in the initial stage of the casting, and the passage of the phosphorus in combustion wastes into stack sludges and water in the gas treatment unit. The weight of the slag was determined which passes from the converter to the ladle during tapping, and its effect on increasing the P content in steel. It was proved that 80 - 95% of the phosphorus from the slag returned to the steel by back reduction. (author). 4 figs., 4 tabs., 3 refs.

318 (INIS-mf—11312, pp 148-154) **Study of crystallization of high-speed steel in industrial remelting.** Firganek, H.; Siewierski, J.; Talarek, R.; Onderka, J. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The radioisotope and metallographic methods were used to identify the effect of the type of crystallizer on the crystallization, structure and segregation of tungsten and the redistribution of carbides in cast and forged high-speed tungsten-molybdenum steel. At constant electric parameters using electrodes with different cross sections, ingots were remelted weighing around 700 kg. The crystallization front, structure and segregation of tungsten were determined by autoradiography using /sup 60/Co for labelling the liquid phase and /sup 187/W obtained by the activation of finished samples in the nuclear reactor. The results of the research became the basis for the technology of electro-slag remelting of high-speed steels. (author). 4 figs., 1 tab., 3 refs.

319 (INIS-mf—11312, pp 163-168) **Radiometric control of trimming semi-finished rolled products.** Vecerkova, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The problems of objectively determining the standard of technologically necessary trimming during ingot rolling were resolved using radioactive tracers. Two methods were used for labelling trial ingots. The centre of the heel of cold ingots was labelled using a point /sup 60/Co source placed in a bore. The same radionuclide was used for labelling cast ingots when a body with a radioactive source was placed on the bottom of the cast-iron mould. The method was used in the rolling of cast-iron moulds of rimmed steel of quality class 37 and for rolling steel of quality RS 3 Ti used for reinforced concrete. The results were used for assessing the effect of soil wear on the position of the heel level of the ingot in the billet body. (author). 4 figs., 4 refs.

320 (INIS-mf—11312, pp 169-177) **Study of steel homogenization with inert gases in ladle metallurgy plant.** Szlauer, J.; Hons, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

A radionuclide tracer technique was used to assess the process of homogenization of steel on a unit for applying compressed inert gases at the oxygen converter steel works in Trinec. The method was applied to two test melts. In order to study the fluctuation of the metal substance, radionuclides /sup 51/Cr, /sup 110m/Ag, /sup 124/Sb and /sup 198/Au were used. Also studied was the deoxidation of steel with granulated aluminium added to the ladle in the course of refining. /sup 46/Sc was used to determine the scattering of aluminium and its oxides in the steel at the beginning and in the course of casting, and also in the finished rolled product. The results have confirmed that the procedure will help to reliably and relatively very quickly verify the efficacy of the operating technology and to obtain objective documents for its optimization. (Z.S.). 6 figs., 6 refs.

321 (INIS-mf—11312, pp 178-190) **Application of autoradiography in metallographic study of boron-alloyed steel and alloys.** Firganek, H.; Zak, A. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The results are presented of metallographic research of boron-alloyed steel and alloys by the method of emulsion free autoradiography using the nuclear reaction /sup 10/B(n,α)/sup 7/Li. The possibilities are presented of interpreting the results, of simultaneous investigation of the distribution of boron and other elements and also of the use of boron as an indicator of certain physicochemical phenomena connected with the technology of steel production. (author). 7 figs., 3 tabs., 7 refs.

322 (INIS-mf—11312, pp 191-197) **Location of defect origin in high-precision castings using radioactive labelling and autoradiography.** Flachowsky, J.; Kulicke, P.; Hartmann, G.; Schuetze, N. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The origin of defects in high-precision castings was studied by radioactive labelling of the inflow system of the casting mould. With regard to the high load of the inflow system at the beginning of the casting process it was assumed that this was the critical point. The tube of the inflow system made of the same material as the mould was labelled with /sup 99m/Tc from a generator or with /sup 198/Au. After the casting had been removed from the mould it was measured with scintillation probes and areas showing radioactivity were autoradiographically imaged. The spatial distribution of contained radioactive particles was identified after abrasion. (author). 10 figs.

323 (INIS-mf—11312, pp 240-251) **/sup 59/Fe distribution in continuously cast aluminium strip.** Kursa, M.; Habrman, P.; Kuchar, L. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The problems are discussed of the homogeneity of continuously cast aluminium strips by horizontal casting. Theoretically discussed are phenomena present during primary solidification, namely the nonhomogeneous distribution of admixtures and impurities in primary solidified dendritic cells. A survey is given of the distribution of coefficients of basic admixtures and impurities in aluminium. Experimental investigation was carried out within the verification of theoretical research results, of the distribution of iron in continuously cast aluminium strips using radioactive iron /sup 59/Fe in form of radioactive foundry alloy containing 1.8% /sup 59/Fe. (author). 13 figs., 1 tab.

324 (INIS-mf—11312, pp 252-260) **Study of /sup 114/In and /sup 110/Ag distribution in zone melting of antimony.** Kuchar, L.; Stas, M.; Habrman, P. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

For 44 binary systems antimony-admixture, steady-state distribution coefficients were determined of admixtures in antimony and their periodical dependence is proposed on the atomic number of the admixture. Experimental concentration profiles of /sup 114m/In and /sup 110m/Ag after zone melting of antimony fully confirm the theoretical assumption that the admixtures accumulate at the end of the refined mould, which has also been confirmed by autoradiography. (author). 8 figs., 1 tab., 14 refs.

325 (INIS-mf—11312, pp 261-267) **/sup 110/Ag distribution in gallium antimonide in directional crystallization.** Kuchar, L.; Goehler, H.; Drapala, J.; Habrman, P. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

In order to verify the efficacy of Ag distribution, experiments were also carried out with the distribution of radionuclide / sup 110/Ag in GaSb which fully confirmed the theoretical assumption of the distribution of Ag in GaSb as a semiconducting compound. The method of micro-alloying of /sup 110/Ag is presented as is the method of directional crystallization and measurement of real concentration gradients of radionuclide /sup 110/Ag in GaSb including autoradiograms. (author). 5 figs., 1 tab., 12 refs.

326 (INIS-mf—11312, pp 268-280) **Tracer techniques used in vacuum distillation study.** Rowinska, L.; Walis, L.; Dalecki, W.; Kusowski, M. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The radiotracer technique is described which was used for investigating the efficiency of zinc, antimony and lead separation from volatile impurities such as Ag, As, Sb during vacuum distillation. Preliminary tests were made to clarify the kinetics of the process of lead distillation and the rate of arsenic evaporation was determined in dependence on time in the process of distillation. (author). 7 figs., 2 tabs., 6 refs.

327 (INIS-mf—11312, pp 281-287) **Application of tracer techniques in investigating regeneration of metal from industrial scrap.** Migdal, W.; Chmelewski, A.; Urbanski, T. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

A method was elaborated of selective extraction of metals (chromium and vanadium) from industrial wastes with possible reuse. Radionuclides were used for elaboration of a treatment of chromium effluents from electroplating workshops using ion exchange, eliminating the generation of a number of harmful sediments of heavy metals and recycling chromium in the production process. A hydrometallurgical technique was developed for extraction of vanadium from fly ash from power plants fired with heavy oil fractions. (author). 4 figs.,.

328 (INIS-mf—11312, pp 288-293) **Kinetics of dissolution of hard additions in reducing copper level in slag in electric furnace.** Palige, J. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

A radionuclide method is presented of investigating the kinetics of the dissolution of hard admixtures - slag and lime -added to the melt. Parts of slag and lime were labelled with radioactive lanthanum oxide and added to the furnace. The cyclic process was studied of the reduction of copper in the slag during copper manufacture in a 600 t electric furnace. Samples taken during the melting allowed to draw a curve of the kinetics of admixture dissolution. Technological instructions were derived therefrom. (author). 3 figs., 2 refs.

329 (INIS-mf—11312, pp 294-301) **/sup 110/Ag distribution in indium in zone melting.** Branzovsky, J.; Kuchar, L. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Zone melting was experimentally carried out of indium with 99.9% purity into which 70 ppm of radioactive isotope /sup 110/ Ag was alloyed. Measurement of the concentration gradients of / sup 110/Ag admixtures after the first three passages through the zone was carried out by the slot method and after the 7th passage by the section method. Effective distribution was attained of /sup 110/Ag in the indium with accumulation of the radionuclide at the end of the mould, which agrees with theoretical assumptions. (author). 3 figs., 4 tabs., 15 refs.

330 (INIS-mf—11312, pp 310-316) **Use of computer technology in processing data on roller bearing wear.** Bejcek, V. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The use of computer technology is discussed in the measurement of the thickness of lubricating films using radionuclides, and the measurement of the wear of roller bearings using tracer techniques is described. The methods are beneficial by improving the knowledge of the accurate process of wear and the identification of emergencies in real time, and especially the verification of new designs and the use of new lubricants while giving information on the wear of the respective parts of the bearing. (author). 1 fig., 5 refs.

331 (INIS-mf—11312, pp 50-58) **Radionuclide method of testing machine part wear.** Tendera, P.; Kosinova, M. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The possibilities are described of in-service monitoring the wear of machine parts using radionuclides. Different methods are evaluated of activating the parts with the aim of attaining optimal conditions with regard to the given purpose of the tests. Wear of different functional surfaces of parts detected by gamma radiation of the radionuclides produced is measured by gamma spectrometry using semiconductor Ge(Li) or scintillation NaI(Tl) detectors. The evaluation of wear is made quantitatively - based on a comparison of the activity of samples with the activity of standards. The method is documented by examples of measurements conducted in cooperation with production enterprises or research institutes. (author). 6 figs.

0704 Economics

REFER ALSO TO CITATION(S) 1913

332 (ACIESP—60-Vol.1, pp 4) **Radioisotopes production for nuclear medicine, in Brazil.** Silva, C.P.G. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

08 HYDROGEN

0801 Production

333 **Process analysis of a dual fluidized bed biomass gasification system.** Prasad, B.V.R.K.; Kuester, J.L. (Dept. of Chemical and Bio Engineering, Arizona State Univ., Tempe, AZ (US)). *Industrial and Engineering Chemistry Research;* **27**: No. 2, 304-310(Feb 1988).

Process data from a biomass dual fluidized bed gasification system were utilized for process modeling and analysis. The objective of the study was to elucidate the effect of the process operating conditions, i.e., the temperature, the steam, the residence time, and biomass feedstock composition, on the performance of the gasifier. The results indicate that there are two distinct regions, the residence time and the equilibrium-dominated regimes. The breakpoints of the two regions were not contiguous. The temperature-residence time interactions determined the temperatures at which these occurred. For optimum performance, the gasification system temperature was chosen to be at an intermediate point where both of the phenomena prevail. Product gas compositions were found to be dependent, based on experimental and equilibrium studies with a number of feedstocks, on the composition of the feedstock. The hydrogen-to-oxygen ratio in the biomass was determined to be the most important parameter that affected the product distribution.

0802 Storage

334 **(CEA-tr—2232) Process for treatment of hydrogen occluded metals.** Oono, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jan 1986. 9p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88754983/JAW.

In the process of activation of metals or alloys for occluded hydrogen storage pulverized metals are treated by a plasma containing hydrogen atoms.

0808 Properties

335 **(N—88-24689) Catalytic ignition of hydrogen and oxygen propellants.** Zurawski, R.L.; Green, J.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 20p. (NASA-TM—100957; E—4104; NAS—1.15:100957; AIAA—88-3300; CONF-880764—). NTIS, PC A03/MF A01.

From 24. AIAA/ASME/SAE/ASEE joint propulsion conference; Boston, MA, USA (11 Jul 1988).

An experimental program was conducted to evaluate the catalytic ignition of gaseous hydrogen and oxygen propellants. Shell 405 granular catalyst and a monolithic sponge catalyst were tested. Mixture ratio, mass flow rate, propellant temperature, and back pressure were varied parametrically in testing to determine the operational limits of the catalytic igniter. The test results show that the gaseous hydrogen and oxygen propellant combination can be ignited catalytically using Shell 405 catalyst over a wide range of mixture ratios, mass flow rates, and propellant injection temperatures. These operating conditions must be optimized to ensure reliable ignition for an extended period of time. A cyclic life of nearly 2000, 2 sec pulses at nominal operating conditions was demonstrated with the catalytic igniter. The results of the experimental program and the established operational limits for a catalytic igniter using the Shell 405 catalyst are presented.

336 **Combustion rate limits of hydrogen plus hydrocarbon fuel: air diffusion flames from an opposed jet burner technique.** Pellett, G.L.; Guerra, R.; Wilson, L.G.; Reeves, R.N.; Northam, G.B. Hampton, VA; National Aeronautics and Space Administration (1987). vp. NTIS, PC A17/MF A01.

Combustion of H_2/hydrocarbon (HC) fuel mixtures may be considered in certain volume-limited supersonic airbreathing propulsion applications. Effects of HC addition to H_2 were evaluated, using a recent argon-bathed, coaxial, tubular opposed jet burner (OJB) technique to measure the extinction limits of counterflow diffusion flames. The OJB flames were formed by a laminar jet of (N_2 and/or HC)-diluted H_2 mixture opposed by a similar jet of air at ambient conditions. The OJB data, derived from respective binary mixtures of H_2 and methane, ethylene, or propane HCs, were used to characterize BLOWOFF and RESTORE. BLOWOFF is a sudden breaking of the dish-shaped OJB flame to a stable torus or ring shape, and RESTORE marks sudden restoration of the central flame by radial inward flame propagation. BLOWOFF is a measure of kinetically-limited flame reactivity/speed under highly stretched, but relatively ideal impingement flow conditions. RESTORE measures inward radial flame propagation rate, which is sensitive to ignition processes in the cool central core. It is concluded that relatively small molar amounts of added HC greatly reduce the reactivity characteristics of counterflow hydrogen-air diffusion flames, for ambient initial conditions.

337 **Mach 2 combustion characteristics of hydrogen/hydrocarbon fuel mixtures.** Diskin, G.S.; Jachimowski, C.J.; Northam, G.B.; Bell, R.A. Hampton, VA; National Aeronautics and Space Administration (1987). vp. NTIS, PC A17/MF A01.

The combustion of H_2/CH_4 and H_2/C_2H_4 mixtures containing 10 to 70 vol pct hydrocarbon at combustor inlet Mach number 2 and temperatures 2000 to 4000 R is investigated experimentally, applying direct-connect test hardware and techniques similar to those described by Diskin and Northam (1987) in the facilities of the NASA Langley Hypersonic Propulsion Branch. The experimental setup, procedures, and data-reduction methods are described; and the results are presented in extensive tables and graphs and characterized in detail. Fuel type and mixture are found to have little effect on the wall heating rate measured near the combustor exit, but H_2/C_2H_4 is shown to burn much more efficiently than H_2/CH_4, with no pilot-off blowout equivalence ratios greater than 0.5. It is suggested that H_2/hydrocarbon mixtures are feasible fuels (at least in terms of combustion efficiency) for scramjet SSTO vehicles operating at freestream Mach numbers above 4.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 336, 337

338 **(BFR-R—71-1987) Cold tolerant mould fungi on softwood timber. Discoloration and production of mycotoxines.** Land, C.J.; Kaeaerik, A. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 38p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88755030/JAW.

The purpose of the investigation is to deepen the knowledge of fungi affecting wooden buildings and sawmill wood and to experimentally investigate the significance of certain parameters (temperature, pH-values in substrates and properties of wood materials) for mould. Further it is to investigate wood inherent fungi's ability to produce mycotoxins in order to evaluate health risks in spaces with potent mould growth such as drying sheds etc. The investigations show that in outdoor attacks by moulds on wooden surfaces in buildings and sawmills a great many species of primarily Penicillum and Cladosporium species are participating. Most of these fungi are cold tolerant and have a low temperature optimum and are still growing close to or even below the freezing point. Their pH-tolerance is high and they establish themselves and grow even at high (alkaline) pH-values in substrates. There is practically no difference in mould attacks on wood cut at different times of the year and treated in different manners. A number of wood moulds were able to produce toxic substances in wood substrates and some developed tremorganic effects at animal tests. (L.F.).

339 (SERI/CP—231-3355, pp 5-20) **Production and upgrading of biomass pyrolysis oils.** Kovac, R.J.; Gorton, C.W.; O'Neil, D.J. (Georgia Institute of Technology Research Institute, Atlanta (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

The continuing research effort on the entrained flow pyrolysis of hardwoods is discussed. This includes: a brief description of the entrained flow pyrolysis system and its operation, experimental progress since May, 1987 and a summary of the modeling effort. The key component of the entrained pyrolysis system is the vertical pyrolysis reactor. The feed may be introduced at various locations providing for a maximum particle travel distance in the reactor of

23.7 feet. Hot combustion products convey the hardwood particles through the reactor. The pyrolysis vapors are condensed to form the liquid oil product. Six experimental runs have been made since May, 1987. Reactor exit temperatures ranged from 498 to 525°C and the dry oil yields ranged from 50.1% to 60.0% based on moisture and ash free feed. Mass and energy balance closures ranged from 100.3% to 104.3% and 97.7% to 104.5%, respectively. Modeling is an integral part of the research and the model is composed of coupled ordinary differential equations which are solved numerically via a computer code. A search routine is used with experimental data to obtain kinetic constants. Results from the modeling effort indicate that oil yields as high as 63% should be obtainable using the present pyrolysis system. An investigation into the catalytic conversion of biocrude oils using zeolite catalysts was initiated. More than thirty screening runs using model compounds were conducted using a wide variety of zeolite catalysts prepared at Georgia Tech. Two candidate catalysts have been selected for further work on biocrude oils.

340 (SERI/CP—231-3355, pp 21-31) **Zeolite catalysts for producing hydrocarbon fuels from biomass.** Diebold, J.P.; Scahill, J.W. Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

The primary pyrolysis vapors generated by the fast pyrolysis of biomass at atmospheric pressures consist initially of low-molecular-weight compounds which polymerize upon condensation. Prior to condensation, these primary vapors have been found to be very reactive with HZSM-5 catalyst to produce methyl benzenes boiling in the gasoline range. This gasoline is predicted to have very high blending octane numbers. A slipstream of wood pyrolysis vapors, generated in SERI's vortex pyrolysis reactor, was contacted with HZSM-5 zeolite catalyst in a fixed-bed reactor. The effect of reaction temperature on product yields and coking rates was investigated. Composition changes of the C_5-C_{10} hydrocarbon products were also observed as a function of temperature. A preliminary experiment was conducted to determine the effects of co-feeding olefins with wood pyrolysis vapors to simulate the recycling of the olefinic fraction of the conversion products. Preliminary experiments to use activated carbon or HZSM-5 at ambient pressure and temperature to adsorb the gaseous olefins from the byproduct fuel gases revealed significant problems to resolve. Wood-to-hydrocarbon yields of approximately 20 weight % are reported.

341 (SERI/CP—231-3355, pp 33-43) **Molecular beam mass spectrometric studies of HZSM-5 activity during wood pyrolysis product conversion.** Evans, R.J.; Filley, J.; Milne, T.A. Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

The conversion of oxygen-rich biomass pyrolysis products to olefinic and aromatic hydrocarbons has been studied in real time using molecular beam mass spectrometry (MBMS). Direct MBMS sampling of the vapors allows rapid analysis of complex gas-phase species: (1) the pyrolysis products and the degree of conversion to hydrocarbons for the major compound classes; (2) the yields of water and carbon oxides, compounds in which rejected oxygen appears; (3) the composition of organic catalyst products, which contain olefins, alkanes, substituted benzenes, furans, and naphthalenes. Methods have been developed that allow yield estimates of the major products, based on the MBMS results. Three of the important parameters influencing yields and product distributions have been systematically screened: temperature; weight hourly space velocity; and feed partial pressure. The effects of these major variables have been studied over the complete catalyst life from initial exposure of the fresh catalyst to the pyrolysis vapor to the breakthrough of feed vapors due to coke deposition and deactivation. These studies have indicated an additional mechanism of aromatic hydrocarbon formation from biomass pyrolysis is present that is not observed in methanol conversion. Studies in steam, rather than the presently used Helium, are indicated. 18 references.

342 (SERI/CP—231-3355, pp 45-55) **Catalytic hydrotreating processes for upgrading biocrude oils.** Elliott, D.C.; Baker, E.G. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—). Contract AC06-76RL01830.

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Catalytic hydrotreating of wood-derived liquids is being studied using a continuous-feed, fixed-bed reactor. Commercial hydrotreating catalysts and conditions are used to hydrodeoxygenate and hydrocrack the biocrude oils generated by high-pressure processing. Biocrude oils from atmospheric flash pyrolysis require alternate processing to first stabilize the products prior to catalytic hydrotreating. Experiments are performed in an upflow reactor wherein both liquid-phase and gas-phase reactions are considered to be important. Although hydrocarbons are not produced in any significant amount by thermochemical direct liquefaction of wood, the use of a secondary hydrogenation step to treat the initial product can result in nearly pure hydrocarbons. These hydrocarbons are primarily cyclic alkanes and aromatics which would be useful in gasoline blending. Recent experimental tests have demonstrated two alternative modes of hydroprocessing. A nonisothermal hydrotreatment for flash pyrolysis oils has been developed and two-step hydroprocessing has been used to simulate on-line recycle and combinations of hydrotreating and hydrocracking. The nonisothermal tests allowed the single-step processing of the flash pyrolyzates to gasoline-range hydrocarbons by hydroprocessing the oil at a low temperature prior to treatment in the higher temperature catalyst bed in which the gasoline is produced. Wastewater treatment and byproduct gas separation and recycle are minimized in this mode of operation. The use of batchwise recycle tests allowed a simulation of the online recycle which is being implemented in the reactor system. In addition, two-step hydroprocessing utilizing both hydrotreating and hydrocracking catalysts was found to have some advantages in hydrogen utilization efficiencies.

343 (SERI/CP—231-3355, pp 57-65) **Advances in direct biomass liquefaction by the extruder-feeder method.** White, D.H.; Wolf, D. (Univ. of Arizona, Tucson (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Biomass including wood could provide liquid fuels on a regional basis if an economic liquefaction process can be developed. Through research sponsored by the US Department of Energy (DOE), under its Thermochemical Conversion Program managed by Battelle PNL, the University of Arizona has developed a unique method of pumping concentrated, viscous biomass slurries, characteristic in biomass direct liquefaction systems. A modified single-screw extruder has now been shown to be capable of pumping solid slurries as high as 60 wt. % wood flour in wood oil derived vacuum bottoms, as compared to only 10-20 wt. % wood flour in wood oil in conventional systems. A Phase II program has integrated the extruder-feeder pumping system with a unique reactor which offers potential for further improving direct biomass liquefaction technology. An experimental facility was constructed during 1983-84, shakedown operations were conducted, and wood crude oil produced by Mid-1985. During the period August, 1985 - April, 1987, a total of 18 experimental continuous biomass liquefaction runs were made using White Birch wood feedstock. Good operability with feed rates up to 30 lb./hr. covering a range of carbon monoxide, sodium carbonate catalyst, pressures from 800 to 3000 psi and temperatures from 350 to 430°C was achieved. Crude wood oils containing 6 to 10 wt. % residual oxygen were obtained. Other wood oil characteristics were reported. Future plans include experimental studies on a variety of feedstocks, and alternative processing steps - all based upon the utilization of the extruder-feeder.

344 (SERI/CP—231-3355, pp 67-75) **Thermochemical conversion of high-moisture biomass feedstocks.** Butner, R.S.; Sealock, L.J. Jr.; Elliott, D.C.; Neuenschwander, G.G. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

A catalytic process for the conversion of high-moisture (> 50 wt% moisture) biomass and related waste materials to medium-Btu gas is being developed by Pacific Northwest Laboratory (PNL). The process, which employs a commercial supported nickel catalyst at temperatures of 350 to 450°C, has been demonstrated in a 1-liter batch autoclave reactor. More than a dozen feedstocks, including aquatic plants, herbaceous energy species, agricultural residues, and food processing wastes have been successfully tested. High methane yields have been obtained from many of these feedstocks, and the calorific value of the raw product gas ranges from 350-560 Btu/scf. A 1-liter continuous reactor system has been constructed and will be used to obtain necessary engineering data required for scaleup of the process. The major accomplishment since the last contractor's review is the design and fabrication of a 1-liter continuously fed reactor system capable of processing up to 4 l/h of biomass slurry at reaction conditions comparable to those employed in the batch reactor system. The continuous reactor system will be used to study the isothermal rate behavior of the catalytic system and to determine the effects of reaction conditions on product yield and quality.

345 (SERI/CP—231-3355, pp 77-86) **Pulse-enhanced biomass gasifier for production of medium Btu gas.** Durai-Swamy, K.; Warren, D.W.; Che, S.C.; Mansour, M.N. (MTCI, Inc., Santa Fe Springs, CA (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—). Contract AC05-84ER80176.

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

An experimental program sponsored by US Department of Energy under the Small Business Innovation Research (SBIR) program was conducted to assess the feasibility of an indirectly heated biomass gasification process employing pulse-enhanced heat transfer. Biomass is reacted with steam in a fluidized bed operated at temperatures of 1000 to 1200°F. Heat is supplied to the reactor from a gas-fired, Helmholtz pulse combustor consisting of multiple resonance tubes which serve as the in-bed heat transfer surface. The gasifier was capable of generating medium-Btu gas of 450 to 500 Btu/SCF with negligible tar production. Overall heat transfer coefficients of approximately 40 Btu/hr/ft^2/F were estimated for this system. These coefficients significantly surpass those which are attainable in conventional fire-tube arrangements. The characteristics of the pulse-enhanced, indirectly heated, biomass steam gasifier resolves many of the limitations of state-of-the-art gasification systems.

346 (SERI/CP—231-3355, pp 87-100) **Improved gasification by catalytic destruction of tars in biomass-derived gases.** Mudge, L.K.; Gerber, M.A.; Wilcox, W.A. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

The Biofuels and Municipal Waste Technology Division of the US Department of Energy is sponsoring studies at the Pacific Northwest Laboratory on catalytic destruction of condensible hydrocarbons (tars) in biomass-derived gases. Currently many biomass gasifiers generate a significant amount of tars in the product gases. These tars create problems with plugging in downstream equipment and with wastewater treatment. Partial oxidation of the gas stream in a secondary fluid bed of catalyst destroys the tars in biomass-derived gases while increasing the energy content of the product gas. Catalysts that remain active for tar destruction are used in the secondary reactor which is specially designed to promote removal of carbon from the catalyst surface while minimizing oxidation of combustible product gases such as CO and H_2. Gases containing tars were generated from wood by pyrolysis, steam gasification, and air/steam gasification in a fluid bed at 725°C. Tars were destroyed and gas yields improved by catalytic partial oxidation in a secondary reactor. Improvement in gas yield depended on conditions in the primary reactor, which influenced the tar content of the wood-derived gases. Tars were converted to gases by partial oxidation in the secondary catalytic reactor at a temperature as low as 600°C. Recent experimental results are presented in this status report.

347 (SERI/CP—231-3355, pp 101-110) **Conversion of RDF to medium-Btu gas.** Feldmann, H.F.; Paisley, M.A. (Battelle Columbus Div., OH (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Battelle is initiating a program to apply its biomass gasification technology to fuels derived from municipal refuse (RDF). This program will be equally supported by US DOE and a private venture, whose objective is to commercialize the technology for biomass and RDF. Since the program is just being initiated, the only experimental result available is from a single test in a small (4 lb/hr) circulating bed gasifier operating on the same principle as the larger PDU. Results of this test indicate that RDF has essentially the same gasification characteristics as woody biomass. This paper describes the technology, the rationale for applying this technology to RDF, the program plan, and the experimental facilities to be utilized for the program.

348 (SERI/CP—231-3355, pp 111-121) **Economic assessment of producing liquid transportation fuels from biomass.** Wan, E.I.; Fraser, M.D. (Science Applications International Corp., McLean, VA (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Recently emerging thermochemical processes may become viable methods of converting biomass feedstocks into high-value liquid transportation fuels. In particular, innovative pyrolysis technologies may present new avenues for converting woody biomass into gasoline. This paper summarizes the evaluation of the economic potential of two advanced biomass-to-liquid fuel processes: (1) a fast entrained-bed pyrolysis process, in which the wood pyrolyzate is upgraded via two-stage hydrotreating to produce gasoline, and (2) a flash ablative pyrolysis process, in which pyrolytic vapors are upgraded via deoxygenation over zeolite catalysts to produce gasoline. The purpose of this evaluation was to determine the economic bounds of these processes and the R & D required to develop them to their full economic potential. The results indicate that gasoline can be produced from a 1000-tpd future biomass conversion plant via fast pyrolysis for about $0.96 per gallon, and via flash pyrolysis for about $1.05.

349 (SERI/CP—231-3355, pp 209-219) **Mass spectrometric studies of municipal solid waste pyrolysis.** Evans, R.J.; Milne, T.A.; Filley, J. Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Molecular beam mass spectrometry (MBMS) has been used to study the pyrolysis of municipal solid waste (MSW). The effects of feedstock variation and reaction conditions on the distribution of reaction products have been studied. MBMS combined with multivariate analysis of the data, allows the definition of compound classes which can be used to characterize both pyrolysis products sampled in real-time and the liquid products collected from other experimental systems. This rapid screening of pyrolysis products provides a data set that can be correlated with formation conditions and with measured properties that are important for potential product end-uses. This paper compares the pyrolysis product composition of 50 RDF samples which show the range of pyrolysis product variability that is likely to be encountered. The effects of pyrolysis conditions on product composition from RDF pyrolysis are demonstrated. The effects of temperature, acid pretreatment, pellet size, and moisture were investigated. The MBMS technique was used to characterize over 50 liquid samples produced from the pyrolysis of wood and the major trends in the data set are discussed. The MBMS oil screening results were correlated with the measured % distillable of the liquids. The relationship of liquid product composition to this important fuel utilization property is discussed. 20 references.

350 (SERI/CP—231-3355, pp 221-235) **Experiments on basic mechanisms of pyrolysis.** Helt, J.E.; Mallya, N. (Argonne National Lab., IL (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

A majority of the combustible portion of municipal solid waste (MSW) is cellulosic in nature, comprising paper, newsprint, packaging materials, wood wastes, and yard clippings. If this material is pyrolyzed, the end products are: a highly carbonaceous solid char, a highly oxygenated liquid tar, and a mixture of gases with low to medium Btu content. All of the pyrolysis products offer the potential of being useful fuels or the intermediates for producing useful fuels. Current research at Argonne National Laboratory (ANL) is focused on obtaining a better understanding of the basic mechanisms, kinetics, and chemistry involved in the pyrolytic conversion of MSW and its components. Newsprint, kraft paper, polyethylene, and densified refuse-derived fuel (RDF) have been used individually and in mixtures as feedstock in a batch laboratory reactor. The pyrolysis has been at atmospheric pressure and temperatures of 350-800°C. The products from the pyrolysis reaction have been analyzed for both fuel properties (e.g., viscosity, calorific value, acid group concentrations) and chemical composition. The liquid products have been studied extensively using Fourier transform infrared spectrometry. Discussion is provided on the overall chemical mechanisms associated with the pyrolytic decomposition.

351 (SERI/CP—231-3355, pp 237-246) **Adaptation of the SERI vortex reactor for RDF pyrolysis.** Scahill, J.; Diebold, J.P. Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Pyrolysis has the potential to produce storable liquid fuels from RDF. Previous attempts to exploit this technology have fallen short, due in a large part to a lack of understanding about the engineering problems associated with RDF feed and its resulting pyrolysis products. The SERI Fast Pyrolysis Process, originally designed for wood pyrolysis, has been adapted for pyrolysis of RDF. Differences in the nature of the feedstock and resulting product tars and oils are described. RDF tar viscosity as a function of temperature is compared to wood oil. Techniques used to solve difficult aerosol collection problems are discussed. Preliminary yield results are given.

352 (SERI/CP—231-3355, pp 247-258) **Principles and operation of a novel pyrolysis mill.** Reed, T.B. (Colorado School of Mines, Golden (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

While conventional pyrolysis produces approximately equal quantities of charcoal, oil and gas, fast pyrolysis has the potential to produce primarily oil vapors which can be condensed to a liquid or catalytically converted to more refined fuels. However, fast pyrolysis requires high rates of heat transfer, while avoiding temperatures over about 600°C which tend to crack the vapors. Heat transfer can be greatly enhanced while avoiding overheating the biomass by pressure contact with a hot solid. A pyrolysis mill has been designed and operated on various forms of biomass to demonstrate this principle. Particles enter between two heated millstones near the center and follow a spiral path to the outer edge where ash falls to a collection area. The vapors are collected in a series of traps. Mass balance data is presented on sawdust, rice hulls, cellulose and methoxylated cellulose. Runs are in progress on lignin and MSW. Sawdust pyrolysis produced a two phase liquid in yields to 54%. Cellulose produced a single phase liquid, but a caramel tar on the furnace surfaces. Examination of the mass balances indicates the requirements for an improved pyrolysis mill, i.e. rapid quench after pyrolysis and more complete coverage of the millstone. A simple model of the operation of the pyrolysis mill is presented in which rotation rate and pressure determine the residence time and degree of pyrolysis. The model predicts a mass flow of 1.7 tons/day for a 1 m diameter mill wheel, and a power consumption of 20 kW.

353 (SERI/CP—231-3355, pp 259-268) **Pyrolysis and combustion of refuse derived fuel.** Levie, B.; Diebold, J.P.; West, R. Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Pellets of refuse derived fuel were pyrolyzed and combusted under different temperatures and oxygen concentrations in a single particle reactor. Pellets were fabricated from components of municipal solid waste and fractional factorial experimental designs were used to efficiently reveal the important components and reactor variables affecting pyrolysis and combustion. The parameters measured in real time were: the surface and center temperatures, the weight of the pellet, and the sensible and latent energy in the product gas leaving the pellet during the course of pyrolysis. In addition to these parameters, the flame temperature, ignition time and heat of combustion were measured, for combustion experiments. Important parameters for engineering applications in commercial pyrolysis reactors, e.g., the heat for pyrolysis, time for pyrolysis and char yield were calculated from the data for each run. Stepwise multiple regression analysis was performed to determine the contributions and significance of each variable to the measured and calculated parameters. The interactions of dependent variables were separated from main effects with additional experiments. Good correlations were found and predictive empirical equations were formulated.

354 (SERI/CP—231-3355, pp 269-280) **Single particle refuse-derived fuel pyrolysis properties and products - initial results.** Lai, W.; Krieger-Brockett, B. (Univ. of Washington, Seattle (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Single particle pyrolyses were undertaken to determine the rates and spatial distribution of chemical reactions and physical processes, such as heat and mass transport, occurring within heterogeneous RDF particles. The objectives of the work are to determine the relationship between: the rates of these processes; pyrolysis conditions; and easily measurable particle properties such as density and composition of the municipal solid waste from which the RDF was made. Initial studies have determined low temperature thermal conductivity, pyrolysis rates and product composition under a limited set of pyrolysis conditions for several representative RDF compositions.

355 (SERI/SP—231-3331, pp 13-28) **Detection of extra-cellular hydrolytic enzymes in anaerobic digestion of MSW.** Himmel, M.E.; Adney, W.S.; Rivard, C.J.; Grohmann, K. Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

In order to develop the maximum conversion rates possible in the production of methane from MSW feedstocks, the slow rate of polymer hydrolysis must be enhanced. This requires an understanding of the important controlling factors governing enzyme production and action in the anaerobic digestion system. This study reports the adaptation of 16 assays for hydrolytic enzymes to the clarified supernatant obtained from digester sludge. From this battery of assays tested, only two activities, alpha-amylase and a general protease, were detectable in supernatant samples from healthy lab-scale digesters fed MSW meal. The particulates present in the anaerobic digesters are now thought to harbor the polymer-binding hydrolytic enzymes important to efficient digester operation. This material was also examined for associated enzyme activity by developing a series of detergent extractions designed to release fully active enzymes from the sludge. Recent studies have shown that using this protocol, cellulase, beta-glucosidase, protease and alpha-amylase activities can be recovered from sludge samples taken from small scale digesters. Also, enzyme activities both from digester supernant and sludge samples were shown to be oxygen insensitive, an issue important to conducting routine assays. Now that the analytical methods are available, assays for hydrolytic enzymes can be used to monitor chemical and metabolic fluxes, as they relate to enzyme activity, in the anaerobic digestion of MSW. 20 references, 8 figures, 2 tables.

356 (SERI/SP—231-3331, pp 29-33) **Photoenhanced anaerobic digestion of organic acids.** Weaver, P.; Maness, P.C. Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

The slow steps of the soluble reactions that occur in anaerobic digestion are the conversion of organic acids into H_2, CO_2, and acetate and the conversion of acetate into methane. Undoubtedly they are slow due to energetic constraints. Photosynthetic bacteria can utilize solar energy to generate ATP, which can then drive energetically unfavorable reactions. Under conditions of low intensity illumination, they readily produced H_2 from organic acids, including acetate. Equilibrium partial pressures of H_2 were well above the K/sub s/ for H_2 of methanogenic bacteria. The isolation of numerous strains of photosynthetic bacteria from actively methanogenic environments suggests that this may be a natural commensalism. Mixed cultures of photosynthetic bacteria with non-aceticlastic methanogenic enrichments exhibited large increases in methane production from acetate, propionate, butyrate, and lactate. The photosynthetic bacteria photoassimilate the organic acids to the level of endogenous sugars and sugar precursors, and then ferment the sugars to pyruvate in a subsequent dark reaction. In Rhodospirillum rubrum pyruvate is cleaved producing formate, which is a precursor to H_2.

357 (SERI/SP—231-3331, pp 34-40) **Effects of hydrogen on acetate degradation by Methanosarcina species.** Boone, D.R.; Mah, R.A. (Univ. of California, Los Angeles (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

Acetate and hydrogen are the major sources of methane in anaerobic digestion, acetate because it accounts for two-thirds of methane produced, and hydrogen also because its concentration controls many other reactions of anaerobic digestion. Hydrogen is an unusual intermediate because its concentration is extremely low (about 0.1 μM). Therefore it turns over very rapidly (perhaps hundreds of times per second) and has the potential to fluctuate rapidly in digestors. Substrate levels of hydrogen inhibit acetate degradation, but the effects of low hydrogen concentrations, such as occur in digestors, is not known and was the subject of this investigation. The authors grew strains of Methanosarcina on acetate, and maintained various concentrations of hydrogen during growth. They found that hydrogen pressure between 2 Pa and about 1000 Pa affected neither specific growth rate nor the rate of methanogenesis. Their data indicated that when hydrogen pressure is very low, Methanosarcina produce hydrogen during growth on acetate, but that the rate of hydrogen production is slow relative to the rate of acetate catabolism, and hydrogen production doesn't significantly affect the stoichiometry of acetate catabolism. 18 references.

358 (SERI/SP—231-3331, pp 52-63) **Effects of trace metals on methanogenesis and control of sulfate reducing bacteria.** McKinney, R.E. (Univ. of Kansas, Lawrence (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

The research over the past 3 years has demonstrated the need for various trace metals in anaerobic metabolism of basic organics. Sodium butyrate was used as the first organic to be studied because it required a complex microbial population for metabolism. Systems were initially studied at 37 and 55°C with 20-25°C temperature systems examined last. Trace metal requirements were used at all temperature levels. Sulfate reduction was examined with sodium butyrate first and then with sodium acetate. While it had been indicated that molybdate inhibited sulfate reduction without affecting methane generation in coastal muds, the data on controlled digesters showed that molybdate was toxic to both the sulfate reducing bacteria and the methane bacteria. It was found that survival depended upon the ability to obtain energy from the organic substrate. Energy-synthesis relationships were examined for sodium butyrate under different HRT-SRT conditions in an effort to understand metabolic relationships. It was found that all systems showed the same solids accumulation each day with 36°C digesters showing less solids than the 24°C digesters. The lower temperature affected the rates of metabolism and the rates of endogenous respiration. Retention of the microbes is critical to high rate metabolism. It was found that the anaerobic bacteria flocculated the same as aerobic bacteria, permitting microbial retention of dispersed systems. Initial fixed media studies indicated bacteria retention was also by flocculation and sedimentation in the media with little adherence of the bacteria to the media.

359 (SERI/SP—231-3331, pp 64-69) **Biological conversion of gasified MSW into methane.** Weaver, P.; Frank, A.; Gauthier, R.; Lundgren, L.; Maness, P.; Lien, S. Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

A large fraction of MSW is strongly resistant to anaerobic digestion, even with long retention times of solids. Thermal gasification can rapidly convert nearly all of the volatile solids of MSW into a relatively homogeneous gas stream consisting primarily of CO and H_2, both of which can be readily metabolized by certain bacteria at ambient temperatures and pressures. 233 distinct bacterial strains were isolated which metabolize CO under various conditions. Of these, 84% proved to be photosynthetic bacteria when tested for growth in the light. About 80% of that number, when incubated anaerobically in darkness, performed a water-gas shift reaction, producing H_2 and CO_2 from CO and H_2O with an apparent stoichiometry of 1:1. Rates were in excess of 1 mmol CO shifted per minute per gram cells. The combined H_2 gas streams are ideal substrates for methanogenic bacteria to produce CH_4. The rate-limiting step in the biological use of gasified MSW is in the mass transfer of the gases from a gas phase into a liquid phase where they can be acted on by bacteria. In order to overcome mass transfer limitations, high concentrations of active bacteria are being reversibly ion exchanged onto electrochemically active electrodes with high surface areas. The electrode-immobilized bacteria will be placed directly within the humid gas stream from a gasifier, free of a bulk liquid phase.

360 (SERI/SP—231-3331, pp 70-74) **Use of monoclonal antibody probes to track external additions of improved hydrolytic microorganisms in a municipal solid waste anaerobic digester.** Conway de Macario, E.; Macario, A.; Rivard, C.J.; Grohmann, K. (State Univ. of New York, Albany (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

Several new anaerobic microorganisms which have improved hydrolytic enzymatic activity, specifically cellulose degrading ability, have been isolated and characterized in the literature. These microbes are of the genus Clostridium and are not the predominant hydrolytic microorganisms in manure digestion systems. The development of a real-time tracking system employing monoclonal antibodies to monitor the external addition of one such microbe, Clostridium populeti, to a standard laboratory scale anaerobic digester is underway. This target microbe has been grown in mass culture and harvested for antibody probe development as well as preserved frozen for later laboratory digester addition studies. The antigenicity of the target microorganism, Cl. populeti is current being tested in laboratory animals. Rabbits and mice were immunized to determine immunogenicity and, eventually, to prepare monoclonal antibody probes. Assays and probes previously developed for studying methanogens were used to study Cl. populeti to determine their applicability to this non-methanogen and to establish whether crossreactions occur. Discussions to coordinate tasks and set forth priorities were entertained and the purchase of instruments are reagents necessary to implement the project was undertaken. Cl. populeti was found to be amenable to immunologic study using the strategies and methods already standardized in their laboratory.

361 (SERI/SP—231-3331, pp 77-90) **Operation of an experimental test unit for the bioconversion of waste and biomass to methane.** Biljetina, R. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

The Gas Research Institute (GRI) has been the primary sponsor of a research program at the Community Waste Research Facility (CWRF) located at the Walt Disney World Resort Complex. Of primary importance to this research effort is the implemen-

tation of low-cost, nonenergy-intensive waste treatment and recovery technologies and the net production of energy (methane) from biomass and waste resources. The production of methane is being studied at the CWRF in a biogasification experimental test unit (ETU). The design of the conversion system incorporates a high degree of flexibility to allow testing with a number of different feedstocks and includes front-end biomass processing and slurry preparation equipment, a cold flow test column, a 1200-gallon digestion unit, digester effluent processing equipment, and gas handling equipment. The primary function of this unit is to validate baseline digester operation and performance data obtained in the laboratory and to evaluate larger scale equipment for material preparation, transport, and unit operations. Results obtained from the ETU provide the basis for complete conceptual process designs and cost estimates for process demonstration units. Design and operation of the ETU are given and results to date are discussed. 7 tables.

362 (SERI/SP—231-3331, pp 91-99) **Future operation of experimental test unit on MSW.** Chynoweth, D.P.; Earle, J.F.K.; Jerger, D.E. (Univ. of Florida, Gainesville (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

Research in their laboratory is concerned with conversion of renewable resources to methane and other useful products. This work which has addressed conversion of community wastes, including sewage sludge, aquatic plants resulting from reclamation of domestic waste water and municipal solid waste, has revolved around an experimental test facility located at Walt Disney World Resort Complex in Orlando, Florida. The authors are proposed continued operation of this facility for process scale-up and its modification for testing of a variety of reactor configurations with emphasis on high solids digestion. Current laboratory research on MSW is described which is emphasizing feed analysis; effects of solids concentration, inoculum-to-feed ratio, and temperature on digester performance; process development research with emphasis on thermophilic digestion in high solids plug flow and leach bed attached film reactors; and wet air oxidation for post treatment of digester effluent. A multidisciplinary approach to evaluation of microbial community structure is described, including use of fluorescent antibodies, nucleic acid probes, lipid analysis, and probes for in situ real-time measurement of NADH (NADPH) for total bacterial activity and F_{420} for measurement of methanogens.

363 (SERI/SP—231-3331, pp 100-111) **Methane from community waste systems: architecture and engineering support.** Legrand, R.; Warren, C.S. (A-E-P, Inc., Jacksonville, FL (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

The nationwide potential of anaerobic digestion was assessed, focusing on the concept of central community waste-to-energy facilities. Municipal solid waste (MSW) has a nationwide potential of 1.2 to 1.6 quad per year; sewage and related solids would add about 5% to this potential. Biodegradable industrial waste is a limited and largely rural resource; the availability of crop and logging residues as well as manures is severely limited for an urban conversion facility. Energy crops have by far the largest potential of all biogas resources. The availability of these different resources to major cities was assessed, using the concept of a surrounding rural hinterland. This analysis was performed on metropolitan areas of three different sizes and the percent of urban energy demand that could be satisfied by the community waste facility was quantified. Since most of the feedstock to a community waste facility will be MSW, an economic comparison was performed of anaerobic digestion of trash versus mass burning, the most likely competing technology. Three possible uses for the biogas were considered, as well as three possible disposal strategies for the digested effluent. A spreadsheet mathematical model of a community waste facility is being designed. It includes modules for MSW preprocessing, sewage treatment with water hyacinths, feed input, kinetics calculation, low and high solids anaerobic digestion, gas and digested residue processing, energy balance and levelized gas cost calculation. Various residue processing options are considered, including land filling, composting, incineration (without power recovery), combustion with power recovery, gasification, and wet oxidation.

364 (SERI/SP—231-3331, pp 117-127) **Processing high solids concentrations of MSW by anaerobic digestion for methane production.** Clausen, E.C.; Gaddy, J.L. (Univ. of Arkansas, Fayetteville (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

Future research on anaerobic digestion must concentrate on reducing reactor volume and enhancing reaction kinetics to move this technology toward commercialization. The use of high solids concentrations for digestion of solid residues affords a potential means of reducing reactor volume by two-thirds. Solids concentrations are limited by conversion in the reactor, such that long retention times are necessary for higher solids concentrations. The use of cell recycle to enhance the kinetic coefficient and series operation of the reactors permit the use of lower retention times and higher solids concentrations. This study has demonstrated the technical feasibility of concentrated solids digestion, cell recycle and series operation. Solids concentrations of 30% have been achieved and retention times as low as eight days have been attained without reduction of the reaction kinetics or conversion. Cell recycle and series operation have been demonstrated to permit lower retention times and higher solids concentrations. Further work should concentrate on defining the optimal system to minimize reactor volume.

365 (SERI/SP—231-3331, pp 128-139) **Processing cellulosic solids for methane production by a combined chemical and biological process.** Tsai, G.; Tsao, G.T. (Purdue Univ., West Lafayette, IN (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

Cellulosic solids are pretreated by calcium hydroxide to produce salts of volatile organic acids and other water-soluble substances. Pure cellulose, sawdust, and waste paper are used as model substances for the study of alkaline degradation. It was found that sawdust is more difficult to degrade than the other two substances. The cooking conditions for high conversion of model substance and high yield of organic acids are found to be 275°C to 300°C with the corresponding reaction time from 30 to 15 minutes. The cooking liquor can be readily fermented in an anaerobic fluidized-bed digester for methane production. The cooking liquor from different reaction conditions can all be digested by the methanogens. Higher than 90% of COD can be removed under the conditions of low organic loading rate ($<$ 2.0 g COD/l/day) and low hydraulic retention time (1.5-2.0 days).

366 (SERI/SP—231-3331, pp 140-158) **Anaerobic high solids fermentation of processed municipal solid wastes for the production of methane.** Rivard, C.J.; Himmel, M.E.; Vinzant, T.D.; Adney, W.S.; Wyman, C.E.; Grohmann, K. Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

A novel reactor that can process high solids concentrations is described for the anaerobic fermentation of lignocellulosic material, specifically, processed municipal solid waste. The reactor has a total volume of approximately 20 liters and is hydraulically driven. The solids in the reactor are mixed by a blade with a horizontal axis. Several different mixing blade designs were tested on uninoculated solids for mixing quality and horsepower requirement, and the blade design requiring the least power input was selected for further study. The reactor has been inoculated with solids, and initial production of methane is reported. 8 references, 16 figures.

367 (SERI/SP—231-3331, pp 159-168) **Bioconversion of MSW and recovery of organic acids.** Antonopoulos, A.A.; Wene, E.G. (Argonne National Lab., IL (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW. Contract W-31-109-ENG-38.

In FY 1987 anaerobic digestion: Annual report.

Research was conducted to determine the feasibility of bioprocessing municipal solid waste (MSW) to produce organic acids and recover the acids for hydrocarbon fuels production. This work focused on acid production from anaerobic digestion of a simulated MSW material, and densified refuse-derived-fuel MSW substrate, using 5-liter continuously stirred and 12-liter packed bed anaerobic digesters. Methane generation was inhibited by heat treatment, ad-

dition of a methanogen inhibitory compound, low pH, inoculum from a long-term acid adapted culture, and short retention times. Steady state operation was reached with acid concentrations of 15,000 to 18,000 mg/l. Nitrogen supplementations to the feedstock increased volatile acid concentrations to between 27,000 to 30,000 mg/l. Aerobic sewage sludge additions to feedstock increased peak levels of acid production to 22,000 mg/l. Acid extraction with trioctylphosphine oxide (TOPO) in heptane extracted more than 82% of the acid content in a single extraction of digester fluids with 15,000 mg/l total acids.

368 (SERI/SP—231-3331, pp 169-179) **Microaerophilic digestion of processed municipal solid waste for the production of organic acids.** Rivard, C.J.; Vinzant, T.B.; Adney, W.S.; Grohmann, K. Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

The effectiveness of microaerophilic digestion of processed municipal solid waste was compared to strictly aerobic and strictly anaerobic digestions with the same feedstock. The processed MSW was apparently poor in nutritional value needed to maintain a robust bacterial population, and research was conducted to identify the nutrient requirements of both the aerobic and anaerobic microbial populations for optimum digestion rates. Initial microaerophilic digester operation is reported.

369 (SERI/SP—231-3331, pp 183-200) **Landfill gas generation and migration: review of current research.** Bogner, J.; Rose, C.; Vogt, M.; Gartman, D. (Argonne National Lab., IL (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW. Contract W-31-109-ENG-38.

In FY 1987 anaerobic digestion: Annual report.

With regard to gas migration, a field investigation is examining bidirectional gas movement through landfill cover materials by processes of pressure and diffusional flow. The overall purpose of the study is to quantify gas loss from the landfill reservoir by natural venting and air influx due to pumping on recovery wells. Two field sites - a humid site with clay cover and a semiarid site with sand cover - have been instrumented to examine vertical gas movement through cover materials. The second major goal is to develop simple assay techniques to examine the gas production potential of landfilled refuse. Refuse samples extracted from various depths in a landfill are being leached by three different methods to separate microbial mass and substrate. The leachates are being subjected to Biochemical Methane Production assays with periodic qualitative examination of microbial populations using fluorescence microscopy of live cultures and scanning electron microscopy. Triplicate assays of the leachates that produce insignificant quantities of biogas after 90 days incubation are being amended with sucrose, a nutrient broth, or a bacterial seed. Response of gas production to each of the three amendments with similar across all samples, regardless of the leaching method originally employed, with nutrient addition producing the most stable long-term biogas production with the highest methane content. 23 references, 6 figures, 3 tables.

370 (SERI/SP—231-3331, pp 213-222) **Research into factors determining anaerobic digester performance.** Speece, R.E. (Drexel Univ., Philadelphia, PA (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

This research falls into 3 phases. The first phase was a study of 30 municipal sludge digesters and development of diagnostic techniques to assay the activity and efficiency of their performance. The second phase was the operation of pilot digesters at a municipal plant to assay the effectiveness of trace metal supplementation on digestion performance at reduced retention times. The third phase was the determination of the minimum concentration of eight essential inorganic nutrients for high rate acetate conversion to methane (e.g. 30-40 g/l-d) at low SRT (e.g. 5 days). In the first phase, 8 of the 30 sludges showed over 20% stimulation in gas production rate when iron, cobalt and/or nickel was supplemented and acetate was unlimiting. Nine of the 30 sludges showed over 20% stimulation with trace metal supplementation when propionate was unlimiting. In the second phase, using domestic sludge in digesters mixed once per day, there was a statistically significant benefit of supplementing trace metals at 10, 6.7 and 5 days SRT. In the third phase, the minimum concentration of the following nutrients was determined which could sustain 30-40 g/l-d conversion of acetate to methane at 5 days SRT (mg/l): N-100, P-4, S-10, Ca-5, Mg-1, Fe-1, Co-0.1 and Ni-0.2. The predominance shift from the slow-growing Methanothrix to the faster-growing Methanosarcina could only be achieved when trace metals were supplemented.

371 **(STEV-FGT—88-5) Gasification of biomass. Final report stage 6.** Andersson, L.; Bitowft, B.; Bjerle, I.; Hallgren, A. (Lunds tekn. hoegskola (SE). Avd. f. Kemisk Teknologi). (Statens Energiverk, Stockholm (Sweden)). 14 Jul 1988. 78p. (In Swedish, English). NTIS (US Sales Only), PC A05. Order Number DE88755088/JAW.

The report falls into four parts, each of them treating the different tasks during the period, namely 1. gasification of biomass in a falling-tube reactor, 2. model for the calculation of heat transfer and dwelling time in the reactor, 3. separation of H/sub 2/S from produced gases at high temperatures as a literature study, 4. gasification of black liquor (literature study). (G.B.).

372 **(STEV-VK—88-3) Combined power and heat production by gasification of indigenous fuels.** Nilsson, C. (Sydkraft AB, Malmoe (SE)). (Statens Energiverk, Stockholm (Sweden)). May 1988. 143p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755105/JAW.

Gasification of biomass has been studied as a presumption of power and heat production at three communes: Karlskrona, Oskarshamn and Nybro. Special attention has been paid to the technique of producing intermediate value gas for gas engines or turbines. Comparative evaluations have been made between low value gas and intermediate value gas as well as conventional back pressure power. New research areas have been identified in order to facilitate development and to lower the expenditure. (With 32 refs.) (G.B.).

373 **(STU-I—582-1986) Gasification of biomass. A means of converting existing oil-fired boilers to burn solid fuels.** Fors, J. (Teknikgruppen AB, Sollentuna (SE)). (Swedish National Board for Technical Development, Stockholm). 1987. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755108/JAW.

Gasification technology provides a means of rapid changeover to solid fuels, since only very minor modifications to existing oil-fired boilers and boiler rooms are necessary in order to convert them to solid fuels. It is felt that, in Sweden, local heating plants would be the most suitable for conversion to solid fuels by gasification. Boiler outputs in local heating plants do not generally exceed about 3 MW. In our opinion, the most interesting fuels are primarily fuel grade wood chips and forest fuels, both having a moisture content of about 50%. The study describes a number of small-scale gasification plants available on the international market and reviews the technology, economics, safety and environmental impact of gasification when applied to the production and use of gas in existing oil-fired boilers. The work was carried out between January 1984 and January 1985. Visits were made to 15 manufacturers of gasification equipment between March and June 1984.

0902 Alcohol Fuels

374 **(AFME—82-371) Application of reverse osmosis to the separation of substances derived from acetonobutylic fermentation.** Driancourt, A.; Dick, R. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754975/JAW.

The main objective of the study was to verify on a large scale prototype plant the concentration process of reverse osmosis applied to fermented juices of Jerusalem artichoke (acetone, n-butanol, ethanol (ABE)) and of beets (isopropanol, n-butanol, ethanol (IBE)). A reverse osmosis membrane with an area of 2 m/sup 2/ have been developed.

375 **(AFME—82-0372) Application of reverse osmosis to the separation of substances derived from acetonobutylic fermentation.** Roz, B.; Nenner, T. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754977/JAW.

A bench-scale experimentation facility has been developed in order to study the reverse osmosis potential for the concentration process of fermented juices of Jerusalem artichokes. A special attention is given to the system pressure control and the outlet flow rate regulation (clock-driven electrovalve). The instruments and reactor characteristics are described and experimental results are presented.

376 **(CONF-881138—2) A state-of-knowledge review of the emissions effects of methanol vehicles.** Hira, A.U.; Timbario, T.J.; Bechtold, R.L.; Singh, M.K.; Sekar, R.R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02. Order Number DE89000535/JAW.

From 8. international symposium on alcohol fuels; Tokyo, Japan (13 Nov 1988).

This paper characterizes the state of knowledge of the emission effects of methanol vehicles. The results of more than 50 recent tests of methanol in single vehicles and small fleets are synthesized. Test results are presented for vehicles powered by spark-ignition and compression-ignition engines fueled by methanol blends or neat methanol. To provide a comprehensive assessment of the emissions characteristics of methanol vehicles, the test results are supplemented by recent estimates by the US Environmental Protection Agency (EPA) of the emission effects of these vehicles. At least six different methanol utilization concepts in compression-ignition engines have been studied. Test results suggest that at the current stage of engine development, HC and CO emissions may increase with methanol, NO/sub x/ and particulate emissions are generally lower, and engine-out aldehydes are greatly increased. Continued evaluation of methanol vehicle emissions is clearly required, because most of the emissions data published to date have been obtained from non-optimized methanol engines. 12 refs., 5 tabs.

377 **(ORNL/TM—10815) Results from the second year of operation of the federal methanol fleet at Lawrence Berkeley Laboratory.** McGill, R.N.; Hillis, S.L. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01. Order Number DE89001338/JAW.

This interim report describes the second year's operation of the methanol fleet at Lawrence Berkeley Laboratory (LBL) in Berkeley, California. The fleet consists of five 1984 methanol-fueled Chevrolet Citation sedans paired with five comparable gasoline-fueled Citations for comparison. Data have been collected and tabulated on fuel consumption, maintenance records, oil sample analyses, and driver perceptions of vehicle operability. Fuel efficiency was slightly improved as compared to the first year for both the methanol and gasoline vehicles. The methanol vehicles continued to experience slightly less energy efficiency than the gasoline vehicles. Maintenance data reveal that the methanol vehicles required substantially more service than the gasoline vehicles, which may be due partially to a greater sensitivity on the part of users about methanol vehicle problems. Oil sample analyses revealed that engine wear rates are lower for the second year as compared to the first year and are probably not cause for great alarm. Drivers still rate all of the vehicles quite highly, but the methanol vehicles were rated not as highly during the second year of operation as in the first year. 5 refs., 1 figs., 16 tabs.

378 **Solvent extraction and recovery of ethanol from aqueous solutions.** *Industrial and Engineering Chemistry Research;* **27**: No. 7, 1330-1332(Jul 1988).

The distribution coefficients of ethanol and water from aqueous solutions to various organic solvents were measured, and separation factors were calculated. Several solvents had ethanol distribution coefficients greater than 0.1 and separation factors for ethanol/water greater than 10. The ethanol was stripped from selected solvents into a carrier gas and recovered by condensation. A conceptual processing scheme is proposed for separating and recovering ethanol from aqueous solutions by solvent extraction followed by gas stripping.

379 **Techniques for producing monodispersed biocatalyst beads for use in columnar bioreactors/sup α/.** Scott, C.D. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp 487-493 of Enzyme engineering 8. Laskin, A.I.; Mosbach, K.; Thomas, D.; Wingard, L.B. New York, NY; The N.Y. Academy of Sciences (1987). (CONF-8509443—).

From 8. enzyme engineering; Helsingor, Denmark (22 Sep 1985).

The use of columnar bioreactors such as fixed or fluidized bed requires that the biocatalyst (e.g., microorganism) be immobilized into or onto solid support materials that will not be swept out of the bioreactor at the high flow rates frequently used in these systems. At the same time, the path length to and through the biocatalyst must be relative short to reduce the effects of mass transport of substrates and products; thus, small particles or thin films of the biocatalyst should be used. In the case of fluidized-bed systems, the resulting particles must also be sufficiently small and dense to ensure fluidization without washout. If active microorganisms are used, immobilization can be carried out by interaction of the cell with a particulate surface or by encapsulation or entrapment of the organisms into a solid matrix such as a hydrocolloidal gel. The latter approach is of particular interest for system where a well-defined microbial population is to be maintained, especially if system asepsis cannot be ensured. Many researchers have investigated the use of gel materials (e.g., calcium alginate and κ-carrageenan) for microbial entrapment, usually with biocatalyst beads (2-5 mm diam.) that were prepared by dispersing droplets of the gel material from a pipette or needle into a cation-fixing solution. The surface properties and specific gravities of the beads can also be altered, as needed, to optimize the intended use. The obvious advantages of this material make it a prime candidate for application in high-productivity, fluidized-bed bioreactors such as those that may be used for the conversion of glucose to ethanol.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 353, 459, 855, 1219, 1478, 1485, 1691, 1692

380 **(DOE/OR/21390—21) Great Lakes Regional Biomass Energy Program: Final report, September 1, 1987--August 31, 1988.** Bancroft, D. (Council of Great Lakes Governors, Inc., Madison, WI (USA)). Sep 1988. Contract FG05-83OR21390. 185p. NTIS, PC A09/MF A01. Order Number DE89002010/JAW.

This is the annual report for the fifth year of operation of the Great Lakes Regional Biomass Energy Program. The program was initiated in 1983 with a grant to the Council of Great Lakes Governors from the Biofuels and Municipal Waste Technology Division of the US Department of Energy. Stressing near-term biomass feedstock production techniques and conversion processes, the objective of the program is to increase the use of biomass energy by the public and private sectors in the seven state Great Lakes region. States that are in the Great Lakes region include: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin. The Great Lakes Regional Biomass Energy Program is divided into three separate operational programs. The first is the State Grant Program, which provides resources to the seven state energy offices in the region to increase their capabilities in biomass energy. State-specific activities and interagency programs are emphasized in the State Grant Program. The second, the Subcontractor Program, involves the letting of subcontracts to private organizations to address regional biomass issues and needs. The third is the In-House Technology Transfer Program in which Council staff develop biomass energy publications and reports.

381 **(FRT—82-6-0436) Forest harvesting evolution. Conditions and effects of an increase in energy-related wood harversting. The Nievre example.** Peguret, A. (Ecole Nationale Superieure des Mines, 75 - Paris (France)). Jun 1984. 376p. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88754980/JAW.

The main characteristics of the national and international context in which the wood industries have evoluted since the world war II are first presented. The situation of the Nievre department in France is then described with emphasis on the rural space development. The various wood industry (harvesting and primary processing) actor behavior since W.W.II in the Nievre department are also analysed and the effects of the new wood utilization as an energy source (domestic or industrial) on these behaviors and relations are examined. Recommendations are proposed.

382 (NEI-SE—20) **Energy crops. Fuels from agricultural crops. Results and evaluations from the governmental energy research program.** (Statens Energiverk, Stockholm (Sweden)). 9 Dec 1987. 93p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755054/JAW.

Results from research projects in the field of agricultural energy sources are reviewed, and plans for future research suggested. The agricultural energy sources include various energy crops, straw and reed but exclude energy forestry. The most promising fuel, with small environmental consequenses, is the straw. More development work is needed in several areas: Handling and transport of straw, development of small combustion plant (<5 MW), effects on the soils of straw harvesting and use of straw ashes as fertilizers. (L.E.).

383 (PB—88-236625/XAB) **Seasonal storage of bark from wet stored logs.** Fredholm, R.; Jirjis, R. (Sveriges Lantbruksuniversitet, Uppsala. Dept. of Forest Products). 1988. 69p. (In Swedish). NTIS, PC E04/MF A01.

The aim of the study was to investigate the possibility of reducing moisture content in bark, removed from wet saw logs, by long-term storage. For this purpose, a total of 2350 cu m (loose volume) of bark was built into 4 sections, two were set indoors and the other two were outdoors. The piles were constructed at a chipping site in Boksholm, Vaxjo in August 1986 and demolished in February 1987. Two sections, 8 m wide by 4 m high and 14 m by 7 m, respectively were set outdoor in one pile, with identical piles set indoors. The gross calorific value (W/sub k/) of the stored bark increased in all the four sections, but the net calorific value (W/sub eff/) remained unchanged or declined after storage. Due to the high dry matter loss the average energy content of the stored bark was reduced by 20 percent while the percentage of ash content increased. The study shows that storage of bark which was removed from saw logs stored in water, is not economically worth while because of the high matter losses and the reduction in the energy content of the material. In addition the presence of high number of spores on the material could be a health risk.

384 (SERI/CP—231-3355, pp 141-148) **Preparation of densified and powder fuels from MSW.** Daugherty, K.E. (Univ. of North Texas, Denton (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

In FY 1984, Argonne National Laboratory (ANL) issued a competitively solicited research contract to conduct a multi-phase research study to examine the use of low-cost binders for use in producing improved pelletized densified refuse-derived fuel (dRDF). The results of the laboratory and pilot plant tests indicated the lime (calcium hydroxide) was the top ranked binding agent. As the third and final phase of the multi-phase study, full-scale cofired combustion tests were conducted of binder enhanced dRDF pellets and high sulfur coal. These tests were conducted during June/July of 1987 in ANL's boiler #5, which is a spread-stoker fired boiler. These tests were conducted with industry, state and municipality participation both in the critiquing of the test plan and in witnessing of the actual test runs. Approximately 600 tons of dRDF, made in two locations, Thief River Falls, MN-Future Fuels, Inc. and Minneapolis, MN-Reuter, Inc., containing binder at levels of 0, 4 and 8%, were blended with high sulfur coal at levels of up to 50% Btu content of dRDF. The analysis of samples taken after the pollution control equipment is described for inorganic acid gases, trace metals and organics including polychlorinated biphenyls, polyaromatic hydrocarbons, dioxins and furans. The analysis of composite ash samples is discussed, as well as future research plans. The powderization of MSW has produced a method to evaluate embrittlement agents and has led to the development of oxalic acid as a prime, although expensive candidate. Further work on this project has been indefinitely delayed. When it resumes the techniques developed will be used to search for more cost-effective candidates. A summary of the work conducted to date is described.

385 (SERI/CP—231-3355, pp 149-160) **System modeling computer code for RDF processing facilities.** Ohlsson, O.O. (Argonne National Lab., IL (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Serious concerns over the disposal of municipal waste (MSW) has stimulated the development of techniques for recovering energy from MSW and specifically, methods for processing MSW into a refuse-derived fuel (RDF) product. Unfortunately, a number of RDF processing facilities which were constructed in the last fifteen years have experienced technical and/or operational difficulties and, as a result, have suffered economic consequences. In order to find ways to overcome these difficulties and to accelerate the further development of this important technology, Argonne National Laboratory (ANL) under the sponsorship of the US Department of Energy contracted with Cal Recovery Systems, Inc. to conduct the research required to obtain the basic understanding and theory of RDF unit processes, and to develop state-of-the-art models for simulating the mass balance, energy requirements, and economics of these unit processes. A follow-on phase of this study, conducted by ANL, used the unit process models developed by Cal Recovery Systems as input into an existing ANL system level computer code. This code has been written in FORTRAN for use on IBM-PC. The model is currently being validated on a unit operation basis under a collaborative US/UK DOE research study being conducted by the Warren Spring Laboratory (WSL). System level validation using data available from existing UK plants will also be undertaken. This paper presents an overview of the models which were developed for simulating the mass, energy, and economic balances of RDF unit processes. The utility of the system model to assess the performance of various RDF processing configurations in order to define technically and economically sound processing alternatives that can produce a desired RDF fuel form is also described.

386 (SERI/CP—231-3355, pp 161-173) **Combustion products kinetics model.** Ahmed, S.; Kumar, R.; Helt, J.E. (Argonne National Lab., IL (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

There is a need to better understand the combustion process, and the processes leading to the formation and emission of toxic or hazardous products, to improve the efficiency and the operation of energy from municipal waste (EMW) facilities. Design and operation of EMW facilities could be improved if an analytical computer model could predict the formation of combustion products under different sets of operating conditions. Preliminary work is being undertaken to determine if adequate data are available to develop a model that would describe the combustion process and the formation of products not only during combustion, but also during cooling of the combustion products in the heat recovery and gas cleanup systems. As an initial step, development of the model at the solid/gas interface at the incinerator grate is underway. Also, collection of available data on the reaction mechanisms and the kinetics of combustion has been initiated.

387 (SERI/CP—231-3355, pp 175-186) **MSW combustion support program.** Bachovchin, D.M.; Keairns, D.L. (Westinghouse Research & Development Center, Pittsburgh, PA (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

One element of this program was the initiation of a set of tests of PCDD (polychlorinated dibenzo-dioxin) and PCDF (polychlorinated dibenzofurans) formation, performed using a versatile, continuously-fed (0.5 to 5 kg/hr), electrically heated (to 1500°C) furnace facility that allows control of temperature independently of fuel/air ratio, while producing significant quantities of product gas. All off-gas is processed with a modified SASS sampling system. In the first test, hardwood chips burned cleanly, producing low CO emissions and negligible PCDDs and PCDFs. In subsequent tests, feedstocks of wood chips with 17 to 33 wt% PVC were used - much higher than with a real MSW feedstock. Operating conditions were purposely set to produce conditions thought to favor PCDD and PCDF formation. Although off-gas oxygen levels were high (11 to 18 mol%), combustion was dirty, with high CO and soot levels. Significant production of PCDDs and PCDFs was found. These results, obtained with exaggerated feedstock compositions and operating conditions, so as to test a hypothesis, verify a single precursor route. Continued tests, utilizing other artificial feedstock compositions and other operating conditions, are advocated as a means of positively identifying other precursors and conditions for formation or survival of these species, and consequently of improving prevention techniques. The results are consistent with the theory that PCDDs and PCDFs are just some of many compounds formed under poor combustion or sooting conditions. Commercial incinerator design technology has advanced to the point that such conditions can be avoided. Better understanding of mechanisms is nonetheless of continued interest, for even finer combustion control.

388 (SERI/CP—231-3355, pp 187-195) **Chlorine mass balance in the combustion of refuse-derived fuel.** Domalski, E.S. (National Bureau of Standards, Gaithersburg, MD (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Chlorinated organic compounds have been reported as present in the ppb and ppt range in the fly ash, bottom ash, and flue gas of a number of refuse-burning incinerators in the US, Canada, and Europe. Public alarm over the fact that many such compounds are toxic has interfered with the construction and operation of many waste-to-energy facilities. As a consequence, the use of municipal solid waste (MSW) and refuse-derived fuel (RDF) as an alternative energy resource is limited and endangered because of a lack of quantitative information on the control of chlorine in the combustion process. An understanding of the chlorine mass balance which results from the combustion of MSW and RDF is necessary to optimize the combustion operating conditions, and thereby minimize the formation of chlorinated organic compounds. Chlorine mass balance studies identify the distribution of chlorine in the combustion products as well as point toward pathways which result in the transfer of chlorine from the volatile to the nonvolatile products. Differences in the combustion process caused by inorganic or organic chlorine in the input waste is considered an important aspect of these studies. Optimization of the combustion of MSW and RDF results from studying the O_2/N_2 flow rate, combustor temperatures, and real-time monitoring of CO, CO_2, HCl, SO_2, and total hydrocarbon content. Also, trace amounts of chlorinated organic compounds from the input sample, volatile products, and ash have been collected and analyzed at Argonne National Laboratory (ANL) to strengthen the focus on optimization.

389 (SLU-IVL—192) **Comparison of storages of chunk wood and fuel chips.** Nilsson, T. (Linkoeping Univ. (Sweden). Dept. of Mathematics). Jun 1987. 89p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755068/JAW.

The present investigation studied the differences in changes in energy value and growth of micro fungi when storing fuel chips and chunk wood. The chunk wood consisted largely of 100 mm long pieces with the same diameter as the original material, whereas the fuel chips were dominated by fractions around 30 mm. The experiment ran for eight months and consisted of the three following treatments: 1) drying silo with a cold-air drier, c. 40-45 m/sup 3/ stored material, 2) net bin, 10 m/sup 3/ stored material, 3) stack, 55 m/sup 3/ stored material, where each treatment comprised two sections, one for chunk wood and the other for fuel chips. The material used in the experiment consisted of unlimbed whole tree parts from an early thinning stand where the removal was to 90% birch and the rest conifers. The result of the component distribution analyses of the material revealed a relatively large proportion of wood and a low proportion of needles/leaves. In both drying silos and stacks a considerably lower temperature increase was registered in the chunk wood than in the fuel chips. The moisture content of the fresh material was c. 40%. After storage the greatest drying of the fuel had occurred in the silos where cold-air drying had been used, c. 30 percentage points. The bins gave a slightly better ventilation than the stacks and it was observed that the chunk wood dried about 10 percentage points more than the fuel chips. The dry matter losses in the drying silos during the storage period were almost negligible. The largest dry matter loss was in the stack with fuel chips, c. 5%, and on average it was 2 perc. points lower for the chunk wood than for the fuel chips in the stacks and the bins. In all three experimental treatments the energy content decreased least in chunk wood. For the bin with chunk wood a positive change in energy content was noted, +4%, which was as much as 6 perc.points greater than in the same storage alternative with fuel chips.

390 (STEV-TB—88-5) **Storage of fuel chips from industrial waste.** Fredholm, R. (Swedish Univ. of Agricultural Sciences, Uppsala (SE). Dept. of Forest Products). (Statens Energiverk, Stockholm (Sweden); Linkoeping Univ. (Sweden). Dept. of Mathematics). Apr 1988. 28p. (In Swedish). (SLU-IVL-U—165). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755090/JAW.

The aim of the study has been to investigate loss of substance, moisture and rewetting as well as temperature progress. The storage was performed at full scale, during 3 and 6 months, respectively. Moisture content increased from 9.45% to 15 %. The parts with the highest moisture content developed the largest microbial activities. Limited loss of substance has been observed, 6.3% and 11.5%, respectively. Small changes of heat value took place. (G.B.).

391 (STU—84-5184) **Refuse derived fuel and material recovery from refuse.** Sundqvist, J.O. (K-Konsult, Stockholm (SE)). (Swedish National Board for Technical Development, Stockholm). 17 Dec 1986. 231p. (STU—81-3702). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88755106/JAW.

Refuse Derived Fuel, RDF, of different characteristics and quality are produced in sorting plants. In Sweden most plants produce a fluff RDF, only one plant produces densified fuel out of household waste. Other countries in Europe tend to concentrate on pellets production. In this study of waste sorting equipment and sorting systems, some interesting waste sorting plants in Europe were visited. Sorting technique was studied as well as aspects of recovered material and marketing. The composition of waste has an influence on sorting technique and recovered material, some data of waste is therefore mentioned.

13 HYDRO ENERGY

1301 Resources And Availability

392 (CONF-8608232—, pp vp) **Utilization of LANDSAT-TM imagery in the hydroenergetic inventory of the Paraiba de Sul River Basin.** Filho, A.P.; Bianco, C.; Sausen, T.M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1986. (In several languages). NTIS, PC A99/MF E03.

From 4. Brazilian remote sensing symposium and 6. SELPER plenary meeting; Gramado, Brazil (10 Aug 1986).

The THEMAG Engenharia Ltda developed a power study in an inventory level in the Paraiba Basin, Sub-basin 2. The aim of this study was to establish in the Paraiba do Sul River and its affluentes (mainly the Sao Manoel, Sopoto, and Novo Rivers) alternatives for power plant schemes in a suitable profile. The TM digital products of the land use studies performed over the planned reservoirs and the surrounding areas were used. The CCT TM Quadrant Digital Products with the desired spectral band selected for

this purpose were useful in identifying and surveying land use categories: urban areas, agricultural ideas, forest areas, grazing areas, and drainage.

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 398

1306 Environmental Aspects

393 (DOE/BP—899, pp 215-221) **Nutritional considerations.** Hublou, W. May 1987. NTIS, PC A12/MF A01. Order Number DE88005264/JAW. (CONF-8505378—).

From Workshop on smoltification and related research; Warm Springs, OR, USA (20 May 1985).

The author outlines some of the considerations and makes some suggestions on the specific nutritional needs of the fish being reared at Columbia River Basin fish hatcheries. A proper diet is an elementary requirement in producing quality capable of surviving to adults.

394 (DOE/BP/61748—2) **Rock Island Dam smolt monitoring, 1987: Final report.** Peven, C.M.; Sheffield, D.H.; Fielder, P.C. (Public Utility District No. 1 of Chelan County, Wenatchee, WA (USA). Power Operations Dept.). May 1988. Contract AI79-86BP61748. 46p. NTIS, PC A04/MF A01. Order Number DE89001538/JAW.

Downstream migrating salmon ({ital Oncorhynchus} spp.) and steelhead trout ({italSalmo gairdneri}) smolts were monitored at the Rock Island Dam bypass trap from 1 April-31 August 1987. Data collected included: number of fish caught by species, number of branded fish caught by species, daily average riverflow, daily average powerhouse {number←sign}1 and {number←sign}2 flows, and daily average spill. These data were transmitted to, and used by, the Fish Passage Center to manage a "water budget" of allocated upstream water storage to augment river flows to improve survival of downstream migrating salmonids. The Rock Island Dam trapping facility collected 84,687 downstream migrating salmonids in 1987. Collected fish included 412 chinook salmon ({ital Oncorhynchus tshawytscha}) and 638 steelhead which had been freeze branded (to determine migration rates) and 608 chinook and 16,519 steelhead with clipped adipose fins. The middle 80% of the 1987 spring migration (excluding sub-yearling chinooks) passed Rock Island Dam during a 30 day period, 27 April-26 May. Passage rates of hatchery released chinook and steelhead smolts and downstream migration timing of all salmonids are presented. 5 refs., 9 figs., 5 tabs.

395 (DOE/BP/64234—1) **Evaluation of fishway designs for downstream passage of spring chinook salmon and steelhead trout smolts, 1987: Final report.** Congleton, J.L.; Wagner, E.J.; Ringe, R.R. (Idaho Univ., Moscow (USA). Coll. of Forestry, Wildlife and Range Sciences). May 1988. Contract AI79-86BP64234. 60p. NTIS, PC A04/MF A01. Order Number DE89001554/JAW.

The stress response of chinook salmon and steelhead trout smolts to passage through three different flumes was tested by assaying plasma cortisol concentrations before and after flume passage. In addition, descaling of fish was recorded before and after flume passage, and the ability of the flumes to pass adult chinook salmon and debris was determined. The three flumes were a corrugated metal flume (CMF), a 4- foot wide baffled flume (BF4), and a 2-foot wide baffled flume (BF2). Each flume was tested under conditions: 1) at night, 2) during the day with a perforated metal cover, which reduced the amount of light entering the flume by about half (partially darkened), and 3) during the day with the perforated cover and additional double layer of black plastic (completely darkened). Plasma cortisol concentrations were not significantly elevated in chinook salmon smolts after passage through any of the flumes ($P>0.2$, ANOVA). In daytime tests of partially and completely darkened flumes cortisol concentrations were consistently decreased following flume passage. We attribute this to pretest stress (holding of fish in small tanks) and to the absence of a strong stress response to flume passage. Flume design did not have a significant effect on cortisol concentrations ($P=0.9$).Total darkening of the flumes during daytime was beneficial: cortisol concentrations were lower ($P=0.03$) in chinook salmon smolts passing through completely darkened flumes than in smolts passing through partially darkened flumes. 16 refs., 15 figs.

396 (DOE/BP/64341—1, pp 123-162) **John Day Fall chinook/salmon mitigation plan acclimation and imprinting site feasibility study Sunnyside Dam site.** Feb 1988. NTIS, PC A 99. Order Number DE88007390/JAW.

In John Day Fall Chinook/Salmon Mitigation Plan acclimation and imprinting site feasibility study: Summary report.

This report present results from an engineering feasibility study of the Sunnyside Dam site as an acclimation facility for chinook salmon. The study is part of the John Day Falls Chinook Salmon Replacement Mitigation Plan. Sunnyside Dam is located on the Yakima River and is one of ten sites evaluated for the ability to provide acclimation and imprinting for 30,000 lb of fry or smolts in four 7500 lb lots. The following information is included: site characterization; production goals; development concepts; water quality and temperature studies; cost summary; and advantages or disadvantages of the site.

397 (DOE/BP/64341—1, pp 399-481) **John Day Fall chinook/salmon mitigation plan acclimation and imprinting site feasibility study Willow Creek Site.** Feb 1988. NTIS, PC A 99. Order Number DE88007390/JAW.

In John Day Fall Chinook/Salmon Mitigation Plan acclimation and imprinting site feasibility study: Summary report.

This report presents results from an engineering feasibility study of the Willow Creek Site, with alternative Three Mile Canyon Site as an acclimation facility for chinook salmon. The study is part of the John Day Falls Chinook Salmon Replacement Mitigation Plan. Willow Creek is on a backwater of the Columbia River John Day Dam Pool in Gilliam County, Oregon and is one of ten sites evaluated for the ability to provide acclimation and imprinting for 30,000 lb of fry or smolts in four 7500 lb lots. The following information is included: site characterization; production goals; development concepts; water quality and temperature studies; cost summary; and advantages or disadvantages of the site.

1307 Power-conversion Systems

398 (DOE/ID/12481—1) **Inexpensive cross-flow hydropower turbine at Arbuckle Mountain Hydroelectric Project: Final construction and cost report.** (USDOE Idaho Operations Office, Idaho Falls; Ott Water Engineers, Inc., Redding, CA (USA)). Jul 1988. Contract FC07-84ID12481. 111p. NTIS, PC A06/MF A01. Order Number DE89002077/JAW.

The Arbuckle Mountain Hydroelectric Project is a Cooperative Agreement between the US Department of Energy (DOE) and Ron and Carlene Ott. The project's purpose is to build and intensively test an inexpensive American-made cross-flow turbine and to provide information to DOE on the cost, efficiency, operation and maintenance of the unit. This final report discusses the technical and financial aspects of planning, designing, manufacturing, and installing the turbine as well as design and construction details of the site.

14 SOLAR ENERGY

1401 Resources And Availability

399 (AFME—84-0958) **Evaluation of the utilization of Meteosat digital images for solar radiation estimation.** Delorme, C. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 52p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755316/JAW.

A review of various studies concerning the evaluation of the solar radiative energy resource through Meteosat images is presented. It appears that many problems reduce the quality of the investigations: unprecise evaluation of the various components of the ground solar radiation; the fair weather quality cannot be rated; the

picture shooting frequency is too low and the image processing used is not really adequate. A rapid and simple processing method is proposed meanwhile, with fairly interesting results.

1403 Economics

REFER ALSO TO CITATION(S) 482

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 405, 406

400 **(PB—88-236922/XAB) Industrial-hygiene walk-through survey report of Optical Coating Laboratory, Inc., City of Industry, California.** Briggs, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 25 Nov 1978. 22p. (IWS—68.16). NTIS, PC A03/MF A01.

A walk-through survey was performed to investigate hazards involved in developing energy technologies. Finished silicon solar panels were produced, starting with ingot growing. Two Czochralski silicon crystal-growing units were used. The vapor space around the crucibles was argon blanketed under a slight positive pressure, causing deposition of silicon oxide on the inner wall which was removed with a dry towel. The cleaning process had a potential for silicon oxide exposure. Detergent cleaning operation for wafers was poorly hooded and involved use of acetone, isopropyl alcohol, sulfuric acid, and hydrogen peroxide.

401 **(PB—88-236963/XAB) Preliminary industrial-hygiene survey of photovoltaic cell manufacturers for solar-energy use, Sensor Technology, Chatsworth, California.** Boeniger, M.; Dobbin, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). 15 Mar 1977. 14p. (IWS—68.10). NTIS, PC A03/MF A01.

A site visit was made to perform a preliminary industrial-hygiene survey. The company produces solar panels, optical switches, photo transistors, photodiodes, tape and card reader heads and printer heads, and other mechanical assemblies related to the photoelectronic field. Minor accidents have occurred related to acid spills and burns. During the visit it was noted that the ingot-slicing machine was not ventilated, allowing some mist to escape. The operation should be fully enclosed to prevent inhalation of silicon. The authors recommend that consideration be given to ventilation systems to control organic-solvent and acid vapors. The use of trichloroethylene should be replaced by a less-toxic solvent. Proper lighting should be offered to reduce eye fatigue. During the final quality testing, a Senon lamp was used to simulate the sun. The possible release of ozone and oxides of nitrogen should be controlled through the installation of a proper ventilation system.

402 **(PB—88-236971/XAB) Industrial-hygiene walk-through survey report of Motorola, Incorporated, Semiconductor Group, Phoenix, Arizona, photovoltaics area.** Briggs, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 4 May 1979. 27p. (IWS—68.15). NTIS, PC A03/MF A01.

A walk-through survey was conducted at the Motorola, Inc., Semiconductor Facility, Phoenix, Arizona, where research was being conducted on photovoltaic-process technologies and finished modules were being produced. The photovoltaics area included processes from wafer to finished module production. Processes used were described, including wafer cleaning and etching, texture etching, junction formation, metallization, and module assembly. Results of the survey indicated that industrial-hygiene controls were excellent, with model chemical handling and accident-prevention systems. The company safety manager and safety engineer inspected all equipment before installation or operation. Medical records were maintained for all personnel. The approach for ventilation control and chemical handling was to provide complete control for all operations and all possible air contaminants.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 381, 382, 384, 385, 386, 387, 388, 389, 474, 475, 476, 477, 478, 855, 1089, 1478, 1691, 1735, 1736, 1865, 1868, 1871, 1892, 1893, 1894, 1895, 1900, 1902, 1986

403 (ACIESP—60-Vol.1, pp 2) **Immobilization and continuous culture of cells with radiation polymerized supports for the uses of biomass conversion processes.** Kaetsu, I.; Kumakura, M.; Fujimura, T.; Tamada, M.; Kasai, N. (Kinki Univ. (Japan); Japan Atomic Energy Research Inst., Tokyo). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

404 **(AFME—85-01-1134) Energetic upgrading of aquatic biomass combined to pollution control.** Dumas, J.P.; Petitbon, A. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 10p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755320/JAW.

A market survey of the nitrate pollution control in rivers has been conducted and demonstrates the potential of aquatic biomass; the nitrogenous compounds are assimulated by the aquatic biomass (Ulvae) which metabolize the ammoniacal nitrogen and the inorganic nitrogen (nitrate and nitrite). Hydrolysis experiments with solubilized enzymes and fixed enzymes are reported and the performance of the combined system (methane production and pollution abatement) are compared with standard denitrification processes.

405 **(BNL—41670) Control of accidental releases of hydrogen selenide in vented storage cabinets.** Fthenakis, V.M.; Moskowitz, P.D.; Sproull, R.D. (Brookhaven National Lab., Upton, NY (USA); Oregon State Univ., Corvallis (USA)). Jan 1988. Contract AC02-76CH00016. 11p. (CONF-880112—2). NTIS, PC A03/MF A01. Order Number DE89001275/JAW.

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

Highly toxic hydrogen selenide and hydrogen sulfide gases are used in the production of copper-indium-diselenide photovoltaic cells by reactive sputtering. In the event of an accident, these gases mat be released to the atmosphere and pose hazards to public and occupational safety and health. This paper outlines an approach for designing systems for the control of these releases given the uncertainty in release conditions and lack of data on the chemical systems involved. Accidental releases of these gases in storage cabinets can be controlled by either a venturi and packed-bed scrubber and carbon adsorption bed, or containment scrubbing equipment followed by carbon adsorption. These systems can effectively reduce toxic gas emissions to levels needed to protect public health. The costs of these controls ({approximately}$0. 012/W/sub p/) are small in comparison with current ({approximately}$6/W/sub p/) and projected ({approximately}$1/W/sub p/) production costs. 7 refs., 2 figs., 2 tabs.

406 **(BNL—41671) Preventing and controlling accidental gas releases.** Moskowitz, P.D.; Fthenakis, V.M.; Kalb, P.D. (Brookhaven National Lab., Upton, NY (USA)). Jan 1988. Contract AC02-76CH00016. 14p. (CONF-880112—4). NTIS, PC A03/MF A01. Order Number DE89001269/JAW.

From Photovoltaics safety conference; Denver, CO, USA (19 Jan 1988).

Toxic, flammable, and explosive gases may be used in photovoltaic cell research laboratories and in commercial manufacturing facilities. Accidental release of these materials can present hazards to life and property. Accidents can arise from a variety of mechanical and human related failures. These can occur from the time materials are received at the loading dock of the facility to the time treated gases are discharged to the atmosphere through a stack. Each type of initiating event may require a different control ap-

proach. These may range from the training and certification of plant workers charged with the handling of gas cylinder hookups to installation of emergency pollution control systems. Since engineering options for controlling released materials are limited, emphasis should be placed on administrative and engineering approaches for preventing such accidents. These are likely to be the most effective approaches for protecting life and property. 18 refs., 3 tabs.

407 (CEA-DRE-STRE-LERS—86-001) **Real environment experimentation of amorphous and polycristalline Si photovoltaic generators.** Ragot, P.; Desmettre, D.; Paes, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. des Reacteurs a Eau). 1985. 48p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755298/JAW.

Tests in real environment have been performed on various photovoltaic cell technologies (monocrystalline, amorphous and polycristalline silicon) and various design (HEM and POLIX). The polycristalline Si module characteristics are compared in natural and artificial insolation, and the aging effect is analysed. The daily energy efficiency for the three types of silicone is studied as a function of the charging type (constant load, maximum load, etc.) and for various day insolation rate.

408 (ESA-SP—267, pp 87-94) **Direct glassing of solar cells.** Dollery, A.A.; White, P.A.; Davies, R.T.; Read, M. (Royal Aircraft Establishment Farnborough (UK)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A new method of bonding a coverglass to the solar cell is being developed by Pilkington Space Technology. An electrostatic process is used which results in a chemical, anodic bond at the interface. This bonding process is permanent and does not degrade the solar cell. The new process eliminates the current adhesive layer. In order to obtain a directly glassed solar cell, it is essential that the coverglass possesses the same thermal expansion coefficient as the silicon. Thus the use of a new coverglass, designated CMZ, is a further bonding process requirement. The advantages of a directly glassed solar cell include reduced array mass, reduced procurement costs and also reduced integration costs. The elimination of the coverglass adhesive will also reduce array outgassing and ensure cleaner spacecraft with associated performance increases. The development work up to the current stage is reported. This includes the theoretical explanation of electrostatic bonding, a description of a development bonding apparatus and also the results of the current direct glassing work.

409 (ESA-SP—267, pp 95-104) **High performance solar array GSR3.** Mamode, A.; Bartevian, J.; Bastard, J.L.; Auffray, P.; Plagne, A. (Centre National d'Etudes Spatiales, 31 - Toulouse (FR)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

In 1984 AEROSPATIALE initiated the development of a third generation rigid fold-out solar array (generateur solaire rigide), called GSR3. This concept differs from the GSR1 product as developed by AEROSPATIALE in 1978 and qualified in orbit on TELECOM 1 and ARABSAT satellites (a total of four flight models) and will soon be flown again on the TV-SAT, TDF-1, TELEX-X and ITALSAT satellites. This paper deals with the development plan, the technical description and tests performed in the frame of the GSR3 program. An overview of the performances is presented.

410 (ESA-SP—267, pp 105-114) **EURECA application of the RARA solar array.** Kam, J. de. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Fokker is developing and testing a retractable, retrievable and re-usable derivative of its ARA solar array (RARA). The array will be applied on EURECA in a 5 kW version. The array is designed for ten years in LEO orbit and five shuttle launch/landing cycles.

411 (ESA-SP—267, pp 115-122) **Improved solar generator technology for the EURECA low earth orbit.** Gerlach, L. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The paper presents the design and related activities of the Electrical Part of the EURECA Solar Array based on the shadow protection requirement and the extreme environment due to the atomic oxygen effects in the EURECA low earth orbits combined with a high (20.000) number of thermal cycles. Trade off studies for the solar cell selection have been performed to determine the optimum cell type in respect to power to mass ratio and cost effectiveness. The paper summarizes the verification program and identifies the solar cell technology to be applied for low earth orbit missions with extended mission life (10 years) equivalent to 60.000 thermal cycles.

412 (ESA-SP—267, pp 123-130) **Inmarsat solar array; the first ARA to fly.** Zijdemans, P.J. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

This paper describes how a project solar array is designed and verified, being a derivative of a generic solar array.

413 (ESA-SP—267, pp 137-144) **GaAs concentrator solar arrays.** Harvey, J.M.; Howard, J.; Haywood, D. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

This paper primarily investigates the use of Gallium Arsenide (GaAs) solar cells in conjunction with concentrator arrays for spacecraft power generation. Two typical missions are used as baselines, one Geostationary, the other Low Earth Orbit. Initially four concentrator concepts are considered, and from these, the optimum concept for each mission is selected. The selected optimum concepts are then subjected to a more detailed study to determine the feasibility of constructing working systems within the constraints of the mission, environment and development of new techniques, processes and materials.

414 (ESA-SP—267, pp 145-150) **Gallium arsenide or silicon array for near future.** Pelenc, L. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

From the performance data of the silicon and gallium arsenide space solar cells of the 90's, we compare the main types of space solar arrays against technical performance and cost criteria.

415 (ESA-SP—267, pp 197-202) **ASGA experiment on EURECA: flight objectives and instrument configuration.** Bertotti, L.; Flores, C.; Paletta, F.; Zuliani, L. (Centro Informazioni Studi Esperienze, Milan (IT); Consiglio Nazionale delle Ricerche, Rome (IT)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The ASGA (Advanced Solar GaAs Array) experiment consists of a solar panel with different GaAs solar cells that will be flown by Eureca-1. During the whole mission electrical and thermal data relevant to different strings of cells will be automatically recorded by a dedicated electronic in order to check the performance trend of GaAs solar cells when exposed to the low earth orbit environment. The Eureca flight gives a unique opportunity to evaluate the properties of standard and advanced GaAs solar cells over a period of 6 months. The Eureca environment (the same as

that for the future space station) is characterized by: high number of eclipses, low radiation density, atomic oxygen erosion. The ASGA experimental will test the effects ot these physical aspects on different kind of cells. On the solar panel, concentrator and planar cells will be mounted.

416 (ESA-SP—267, pp 203-206) **Spot solar array in-orbit deployment results evaluation.** Bobo, P. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The design and deployment sequence of the SPOT satellite's flexible solar array are briefly recalled. Then, we describe the analysis tools whereby in-orbit behaviour can be retrieved. The results from telemetry deliveries are presented and evaluated so as to derive the solar generator flight data. Such performances are compared, when possible, to the predictions or simulations. The performance budget evidences good performance-prediction correlation, thereby increasing confidence level for this solar array subsystem, three specimen of which are now under production.

417 (ESA-SP—267, pp 207-212) **Electrical performance comparison BSFR-/bifacial solar cell array.** Hoffmann, U.; Reissmann, F. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The bifacial solar cell is able to convert beside the normal sun iradiation on its frontside also the radiation coming from earth (albedo- and IR-radiation) in the low earth orbit into electrical energy. To demonstrate the performance advantage of this cell a comparative electrical analysis has been performed between the conventional- and bifacial solar array on subsystem level. As reference the Space Telescope-Solar Array/-Mission has been taken.

418 (ESA-SP—267, pp 213-224) **Aerospatial solar arrays, in orbit performance.** Juillet, J.J.; Samson, P.; Pelenc, L. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

For over 15 years, AEROSPATIALE have developed and constructed solar arrays for a wide range of space applications. During the past two years, many efforts were rewarded with the successful orbiting of 10 solar array wings designed and built by the CANNES Establishment of AEROSPATIALE in collaboration with AEG for the electrical network. The evaluation of the telemetry data received at the ground stations started in 1986. The first results, presented in this paper, show a good correlation between on-ground prediction and in-orbit mechanical and electrical behaviour for TELECOM 1/ ARABSAT and SPOT programs.

419 (ESA-SP—267, pp 231-240) **Solar dynamic power concept: terrestrial experiences and their extension to space applications.** Lucifredi, A.; Ravina, E.; Repetto, F. (Genoa Univ. (IT); Ansaldo S.p.a., Genoa (IT)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The concept of solar energy high temperature thermodynamic conversion, which has been operational since 1961 in practical applications at the Genoa S. Ilario Solar Test Facility, is a serious candidate to have a new, technologically close, technically and economically convenient application in the space field. The paper preliminary examines the characteristics of some of the most significant projects and installations of solar thermal concentration power systems for terrestrial applications. Specific designs and experiences on steam and gas solar plants and components developed by the S. Ilario Solar Test Facility and by ANSALDO are reported. A comparison among the various plant alternatives for use in solar dynamic power systems (photovoltaic, solar dynamic, nuclear) shows the existence of an intermediate range of power where a potential exists for the use of solar dynamic systems adopting parabolic dish concentrators and cavity receivers. On the basis of their experiences and of computer codes for parabolic dish systems and cavity receivers, the authors give special attention to the problems for the successful development of the dynamics conversion system arising from the peculiar environmental conditions and from the particular requirements on reliability, maintainability and lifetime, which affect the components and system characteristics. A possible use of the thermo-solar orbiting converter, besides the electric power generation, could be, in addition, to satisfy thermal loads (melting, chemical reactions, heating).

420 (ESA-SP—267, pp 247-252) **50 microns thin solar cell assembly and environmental tests.** Hashimoto, H.; Aoki, Y.; Iwakami, M.; Nishiyama, H. (National Space Development Agency, Tokyo (JP); Toshiba Corp., Kawasaki, Kanagawa (JP)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A solar panel assembly study was completed successfully to establish a suitable way to incorporate the ultrathin silicon cell (50 microns, BSFR) into the solar array. Two types of welding methods - Parallel Gap Welding method (PGW) and Improved Solder Welding method (ISW) - have been introduced to interconnect these cells, and special quality control through the manufacturing process were implemented. Both methods were evaluated by comparing the results from several environmental tests-thermal cycle, thermal vacuum, vibration, shock and acoustic tests - on light weight lattice panel and semi-rigid panel. No weld joint failures or electrical degradation were observed during all testings. These results indicate the suitability of both welding method PGW and ISW for ultrathin solar cells. The validity of assembly and accommodation technique to the substrate were also confirmed. These assembly technology will be applied to the Earth Resources Satellite (ERS-1) and Engineering test Satellite-VI (ETS-VI) of Japan.

421 (ESA-SP—267, pp 253-256) **Thin single-crystalline silicon solar cells for space applications.** Nijs, J.; Caymax, M.; Acke, P.; Roggen, J.; Lambrechts, M.; Gravesen, P. (Louvain Univ. (BE); Danmarks Tekniske, Hoejskole, Lyngby). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A normal high efficiency process on etched substrates can result in bad solar cell characteristics and uncontrollable final thickness of the cell. Therefore a technology is proposed here to perform the etching after the formation of the solar cell, using an epitaxial deposition process of the active layer of the cell combined with an etch stop technique. This can result in highly efficient silicon solar cells with thicknesses down to 10 microns.

422 (ESA-SP—267, pp 257-260) **Status and prospects of indium phosphide based solar cells for space use.** Pearsall, N.M.; Hill, R.; Dollery, A.A. (Newcastle upon Tyne Polytechnic (UK); Royal Aircraf Establishment, Farnborough (UK)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

For use in space, solar cells should have a high power/mass ratio and a high resistance to the degradation caused by exposure to radiation in the space environment. Recently, significant gains in efficiency have been obtained for cells based on indium phosphide and initial tests indicate that these cells have a superior radiation resistance to that of either gallium arsenide or silicon based cells. This paper discusses the current state of development of these cells and presents data on efficiency targets and power/mass ratios. End-of-life data, in particular, suggest that indium phosphide based cells have the potential to be highly competitive with alternative types of cell for use in space.

423 (ESA-SP—267, pp 261-270) **State-of-the art of solar cell welding technology at ISRO-experiences and future plans.** Srinivasamurthy, N.; Sudhakar, M.; Sharma, S.K.; Agrawal, B.L. (Bangalore Univ. (IN)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Indian Space Research Organization has taken up development of solar array technology during the early seventies to meet the power demands of the Satellites developed at ISRO. The methodology adopted at ISRO for solar cell interconnection is welding. The technological progress made in the solar cell welding technology and the various facilities established in this regard are presented in this paper. During welding technology development, various problems faced relating to fabrication and quality control are also discussed. It is to be noted that much more work is needed in establishing such a technology for it to be widely accepted. The experiences gained at ISRO and the futuristic work, contemplated in various aspects, are also presented.

424 (ESA-SP—267, pp 271-274) **New generation of coverglasses.** Dollery, A.A.; Kitchen, C.A.; White, P.A.; Yale, B.; Fyles, K.M. (Royal Aircraft Establishment, Farnborough (UK)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A new generation of coverglasses has been developed which possess all the properties of the existing range, i.e. CMX, but with a thermal expansion coefficient which matches that of silicon over a wide temperature range. This has the advantage of maintaining optical efficiency whilst minimizing the interface stresses between the solar cell and coverglass as the temperature of the array varies with orbital position. In addition, the matched thermal expansion coefficient makes possible the application of coverglass integration techniques other than the conventional use of silicone adhesives, e.g. Electrostatic bonding, Teflon bonding, rigid adhesive, encapsulation and also large area coverglasses used as superstrates. The paper will present the new coverglass material, designated CMZ, and will detail its optical and physical characteristics. The availability of CMZ as a space qualified production coverglass will also be discussed.

425 (ESA-SP—267, pp 275-280) **Improved performance solar cell coverglasses and second surface mirrors.** Whalley, A.M.; Jones, D.P.; Mullaney, K. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

New coatings have been developed at Pilkington PE and Pilkington Space Technology for use with solar cell coverglasses and second surface mirrors for satellite thermal control. These new coatings are designed to provide improved thermo-optical properties compared with existing products. The first coating has an enhanced infra-Red Emittance. Use of this can boost the emittance for uncoated or visible anti-reflection coated CMX by at least 4%. This means that the coverglass and SSM can radiate heat more efficiently hence reducing the temperature of the solar cell and the satellite body respectively. The second coating has been designed to introduce a reduced solar absorptance. Theoretically the value can be decreased by 0.04 using this coating. This reduction means that the heating effect of the sun on the coverglass or SSM itself, will not be so great and in this way, again, a lower temperature may be maintained. This paper describes the properties of the coatings and gives the results of tests carried out to date, which indicate that a significant improvement in product performance has been successfully achieved.

426 (ESA-SP—267, pp 281-286) **Bifacial silicon solar cells in space: AR coatings and thermal behaviour.** Correig, X.; Calderer, J. (Universidad Politecnica de Barcelona (ES)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Bifacial silicon solar cells efficiency, anti-reflection coating design and operation temperature are three variables of which the first one is related to the other two by optical, electrical and thermal behaviour of the structure. An approach to ARC design that takes into account these factors is presented under a certain number of assumptions. The main hypotheses are: AMO illumination on the front side simultaneously with an isotropic albedo on the back side, coverglass and substrate foil (with their adhesives) as semi-infinite non-absorbing media and a TiO/sub 2/ anti-reflection coating on both sides. Thickness of this film is optimized in order to reach maximum efficiency. Absortance and operating temperature are also obtained along the calculations. Mass per unit area of bifacial arrays is estimated in order to compare their thermal cycle with those of monofacial cells.

427 (ESA-SP—267, pp 287-292) **Connector integrated thin silicon solar cells attached interconnectors by alternating current welding machine.** Matsutani, T.; Saga, T.; Kaminishi, S.; Ogura, M.; Hagihara, Y.; Hirano, T.; Suzuki, A.; Ushirokawa, A. (Sharp Corp., Osaka (JP); Institute of Space and Astronautical Science, Tokyo (JP)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Connector Integrated Cells (CIC's) with photoetched silver mesh interconnectors have been developed to achieve easy handling of thin silicon solar cells. Interconnectors with in-plane stress relief were chosen because they do not protrude from top surface of CIC's. The fatigue life time of interconnectors with in-plane stress relief was found to meet the requirement for 10 year life on the geostationary orbit when assumed that CIC's were laid down on an aluminum honeycomb substrate. Silver needs more welding current than other materials to obtain sufficient welding strength due to its lower resistivity. Then the direct current welding machine takes very long time to charge up its batteries of welding power source. To increase the throughput of welding process, the alternating current welding machine which does not need charging time at all was introduced. CIC's have been qualified by Institute of Space and Astronautical Science (ISAS) and National Space Development Agency of Japan (NASDA). ISAS decided to employ CIC's for the solar array of the 12th scientific satellite, EXOS-D.

428 (ESA-SP—267, pp 293-296) **UV Cut performance of cover glasses for solar cells of satellites.** Matsuda, S.; Kimura, T.; Haruyama, K. Kijima, T.; Moriguchi, Y.; Tamamura, R. (National Space Development Agency, Tokyo (JP); Asahi Glass Co., Ltd., Tokyo (JP)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The performance of satellite solar cells and their service life are affected by corpuscular radiation. To reduce the effect of corpuscular radiation, cover glass is attached to each solar cell. But because the adhesive used becomes opaque due to the optical damage caused by ultraviolet rays, it is necessary to provide the cover glass with ultraviolet ray interception ability. This paper determines the practical ultraviolet cut-on wavelength through tests.

429 (ESA-SP—267, pp 313-316) **Analysis of low energy proton GaAs solar cells degradation.** Garcia Moreno, E.; Prat, L.; Alcubilla, R.; Castaner, L.; Correig, X. (Escuela Tecnica Superior de Ingenieros Industriales, Barcelona (ES)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A comprehensive set of theoretical models have been developed and implemented as software tools aimed to calculate the radiation induced degradation of GaAs solar cells in proton environment. Main photovoltaic characteristics parameters are calculted after the accurate defect induced profile determination following a

proton exposure both isotropic and normally directed to the cell surface. Results include the estimation of the effect that the range straggling may have in the overall photovoltaic response. The results, are compared with available experimental data to assess the validity of the model and pertinent assumptions. The damage coefficient relative to 10 MeV protons shows a maximum at 150 KeV for the particular geometry considered.

430 (ESA-SP—267, pp 317-320) **Thermal-electrical dynamical simulation of spacecraft solar array.** Reticcioli, M. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

This paper describes an approach to model both electrical and thermal behaviour of spacecraft electronic subsystem. A special feature of this method is the possibility to take dynamically into account, at the same time, both thermal exchange and electrical effects in circuit simulation of spacecraft units. This approach is specifically applied to simulate the electrical-thermal behaviour of a spacecraft primary power generator (solar array). The method could also be applied by suitable manipulation to any other electrical and thermal simulation of spacecraft electronic subsystem.

431 (ESA-SP—267, pp 327-332) **METEOSAT solar array.** Schmidt-zur Borg, J. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The design of the electrical part of the METEOSAT Solar Array is presented. Design aspects as layout connections, wiring, solar cell assembly, interface between electrical part and mechanical part are described. The basis of the power calculation is mentioned and special aspects of the power output as the power ripple are explained. The qualification test programme is listed in detail and interesting test results are reported.

432 (ESA-SP—267, pp 333-342) **Design and fabrication of stretched rohini satellite-1 solar array.** Srinivasamurthy, N.; Sudhakar, M.; Agrawal, B.L.; Gopalan, A.U. (Bangalore Univ. (IN); Vikram Sarabhai Space Centre Trivandrum (IN)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Indian Space Research Organization has planned a series of satellites of the 150 Kg class during eighties for various scientific missions. The mission demands are such that both spinning, as well as 3-axis established satellites are required. A single bus satellite design scattering to both the type of mission requirements has been evolved. This particular requirement has imposed severe constraints on the solar array design. The various options considered and the final choice made is presented. The first of the series, namely SROSS-1 is ready for launch. The fabrication methodology followed for the SROSS-1 solar array is also discussed. The indigenously developed solar cells from Bharat Electronics Ltd., India have been used for SROSS-1. The qualification plan followed and the CIC technology developed for these cells are also briefly presented.

433 (ESA-SP—267, pp 343-352) **Theoretical quantification of nonlinear effects in silicon solar cells.** Ruiz, J.M. (Universidad Politecnica de Madrid (ES). Escuela Tecnica Superior de Ingenieros Industriales). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A theoretical analytic model for the internal quantum efficiency of solar cells is presented and discussed. It is specially intended for explanation and quantitative analysis of some nonlinear effects in silicon solar cells. The model differs from conventional ones in that it considers trap-filling as well as ohmic electric field effects on carrier recombination. The responsibility of both effects for quantum efficiency enhancement (superlinearity) are analysed. The field effect is found to be the only one having some little influence at the irradiance ranges usual in spectral response measurements. Very simple formulae accounting for nonlinear effects are finally obtained. Quantitative results for a typical 10 Ω cm. p-type base silicon solar cell are presented.

434 (ESA-SP—267, pp 353-358) **Modelling bifacial silicon solar cells for space degradation prediction.** Prat, L.; Garcia-Moreno, E.; Alcubilla, R.; Castaner, L.; Ruiz, J.M. (Escuela Tecnica Superior de Ingenieros Industrials, Barcelona (ES); Universidad Politecnica de Madrid (ES). Escuela tecnica Superior de Ingenieros Industrials). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Silicon bifacial light sensitive solar cells have been modelled by an accurate calculation of the profile of induced defects, resulting after irradiation and by the transport equations solution through the cell structure with the appropriate boundary conditions. The main results show that the bifacial benefits are loosed after a certain fluence of 1 MeV electrons or 10 MeV protons. The effect of proton energy has been analysed and a maximum of degradation has been found. Back surface proton irradiation damages first the high -low back junction.

435 (ESA-SP—267, pp 391-396) **Spectral response measurements of silicon solar cells for space qualification.** Carabe, J. (European Space Research and Technology Centre, Noordwijk (NL)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The present work aims to contribute to a better understanding of the problems encountered when routine spectral responsivity tests to qualify silicon solar cells are performed. A theroretical basis of the measurement is presented allowing us to check the validity of the approximations which have to be done as well as to analyse a set of important error sources which must be taken into account in order to obtain reliable results. After this, several tests done at ESTEC, using its pulsed light source facility, are described. Three cells were tested with two different flash units at several irradiance levels. One of these cells was a BSF one in order to check whether spectral responsivities of this kind of cells can be satisfactorily measured with pulsed light sources.

436 (ESA-SP—267, pp 397-402) **Absolute indoor calibration of large-area solar cells.** Metzdorf, J.; Wittchen, T.; Kaase, H. (Physikalisch-Technische Bundesanstalt, Braunschweig (DE)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A description of the equipment for the accurate calibration of reference solar cells at PTB which is traceable back on their primary radiometric standards is presented and the peculiarities are discussed. The apparatus, based on the Differential Spectral Responsivity method (DSR method) which is an absolute indoor procedure wihout reference solar cells, needs no solar simulator. The method is applicable to all kinds of test devices up to solar cell areas of 10*10 cm/sup 2/ without any requirements on linearity and spectral responsivity of the cells.

437 (ESA-SP—267, pp 403-408) **Very low temperature rise laser annealing of the radiation damaged solar cells in-orbit.** Poulek, V. (Czechoslovak Academy of Sciences, Prague (CS)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

For successful annealing of the solar cells damaged by 10 years radiation dose in-orbit it is necessary for the temperature rise in the incidence point of the laser beam to reach about 400/sup 0/

C. By continuous regeneration, however, between two annealing cycles the solar cells are hit by about two orders of magnitude lower radiation dose. This makes it possible to carry out the regeneration at temperature rise deep under 1/sup 0/C. If optimal laser regeneration system is used, such low temperature rise laser annealing of the radiation damaged solar cells is possible. A semiconductor GaAlAs diode laser with output power up to 10 mW CW was used for annealing. Some results of the very low temperature rise annealing experiment are given in this paper.

438 (ESA-SP—267, pp 409-414) **Test equipment for reverse and Forward I.V. Characteristics.** Samson, P.; Dides, C.; Laugeri, J. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

This paper aims at presenting the main requirements and performance characteristics of new laboratory device designed and constructed by AEROSPATIALE to measure the current-voltage characteristics of solar cells over a wide range of temperatures. The most interesting features of such equipment is its ability to measure forward and reverse I.V. (current-voltage) characteristics on different types and sizes of solar cells. The idea underlying the CNES/AEROSPATIALE contract for the development of this test equipment was to update knowledge of I.V. data for new solar cell types, enabling correlation of I.V. curve modelling.

439 (ESA-SP—267, pp 415-420) **Radiation damage in proton irradiated indium phosphide solar cells.** Weinberg, I.; Swartz, C.K.; Hart, R.E.J.; Yamaguchi, M. (National Aeronautics and Space Administration, Cleveland, OH (US). Lewis Research Center; Ibaraki Electrical Communications Lab., Tokay (JP)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Indium phosphide solar cells exposed to 10 MeV proton irradiations were found to have significantly greater radiation resistance than either GaAs or Si. Performance predictions were obtained for two proton dominated orbits and one in which both protons and electrons were significant cell degradation factors. Calculations of array specific power were performed using lightweight blanket technology, a SEP array structure and projected cell efficiencies. The results indicate that arrays using fully developed InP cells should outperform those using GaAs or Si in orbits where radiation is a significant cell degradation factor.

440 (ESA-SP—267, pp 421-424) **Mismatch corrections of solar cell spectral response measurements with a reference cell.** Ruiz, J.M.; Cid, M. (Universidad Politecnica de Madrid (ES). Escuela Tecnica Superior de Ingenieros Industriales). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Spectral response measurements performed by the common method of using a reference cell of calibrated spectral response and a set of narrow band interference filters are shown to suffer from an inherent error, coming from the unavoidable finite bandwidth of interference filters. The so-called spectral response mismatch error is analysed and quantified. A simplified procedure for first order analysis, and a more complete one for practical correction of spectral response measurements are both outlined. The usefullness of the procedure to indirectly perform real time checks of measurement setups is also discussed. Some results taken from routine measurements performed on different technology cells with the same reference cell are finally presented.

441 **(FRNC-CONF—247) Solar energy direct bioconversion and photochemistry.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 262p. (In French). (CONF-8501122—). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88754978/JAW.

From Seminar on solar energy direct bioconversion and photochemistry; Sophia-Antipolis, France (31 Jan 1985).

The workshop communications on direct bioconversion of solar energy and photochemistry are reported: study and enhancement of photosynthesis, solar biotechnology (continuous cultivation of suspended cells and immobilization of cellular or sub-cellular structures in substrates permeable to light and allowing gaseous and metabolite transfers), and photochemistry and photoelectrochemistry concerning solar connection (generally monophotonic): semiconductor-electrolyte electrode systems, photocatalysis in solid-liquid systems, charge transfer in a transitory dissolved complex.

442 **(FRNC-TH—3254) Study of the amorphous silicon-cristalline silicon heterojunction: a model of a photovoltaic tandem cell and an analysis of the electronic structure by internal photoemission.** Cuniot-Ponsard, M. (Paris-7 Univ., 75 (France)). 1986. 140p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755305/JAW.

A modelization of a photovoltaic tandem cell combining a hydrogenated amorphous silicon photocell and a polycrystalline silicon photocell is developed. The optimal parameters and the system performances are analysed through a simulation process. The amorphous silicon-crystalline silicon interface is experimentally studied with the internal photoemission process and the band discontinuities at the interface are determined.

443 **(FRT-81-G—0983) Analysis of the ecological problems bound with algae biomass harvesting in lagoon waters.** Chassany de Casabianca, M. (Montpellier-2 Univ., 34 (France)). Dec 1984. 88p. (In French). NTIS (US Sales Only), PC A05. Order Number DE88755299/JAW.

The aim of this work was to analyse the growth of algae in two lagoon ecosystems: a natural open lagoon water plan and a semi-artificial eutrophicated pool. The growth conditions are optimized as a function of ecological parameters, harvesting cycle and harvest load. The organic matter required and the water purification effect are also studied.

444 **(N—88-24111) Three-dimensional models of conventional and vertical junction laser-photovoltaic energy converters.** Heinbockel, J.H.; Walker, G.H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1988. 21p. (NASA-TM—4039; L—16424; NAS—1.15:4039). NTIS, PC A03/MF A01.

Three-dimensional models of both conventional planar junction and vertical junction photovoltaic energy converters have been constructed. The models are a set of linear partial differential equations and take into account many photoconverter design parameters. The model is applied to Si photoconverters; however, the model may be used with other semiconductors. When used with a Nd laser, the conversion efficiency of the Si vertical junction photoconverter is 47 percent, whereas the efficiency for the conventional planar Si photoconverter is only 17 percent. A parametric study of the Si vertical junction photoconverter is then done in order to describe the optimum converter for use with the 1.06-micron Nd laser. The efficiency of this optimized vertical junction converter is 44 percent at 1 kW/sq cm.

445 **(N—88-24870) Progress in InP solar cell research.** Weinberg, I.; Brinker, D.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 16p. (NASA-TM—100914; E—4166; NAS—1.15:100914; CONF-880702—). NTIS, PC A03/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Progress, in the past year, in InP solar cell research is reviewed. Small area cells with AMO, total area efficiencies of 18.8 percent were produced by OMCVD and Ion Implantation. Larger area cells (2 and 4 sq cm) were processed on a production basis. One thousand of the 2 sq cm cells will be used to supply power to a small piggyback lunar orbiter scheduled for launch in February 1990. Laboratory tests of ITO/InP cells, under 10 MeV proton irradiation, indicate radiation resistance comparable to InP n/p homojunction cells. Computer modeling studies indicate that, for identical geometries and dopant concentrations, InP solar cells are sig-

nificantly more radiation resistant than GaAs under 1 MeV electron irradiation. Additional computer modeling calculations were used to produce rectangular and circular InP concentrator cell designs for both the low concentration SLATS and higher concentration Cassegrainian Concentrators.

446 **(N—88-25831) Aging behavior of Au-based ohmic contacts to GaAs. Final contractor report.** Fatemi, N.S. (Sverdrup Technology, Inc., Cleveland, OH (USA)). Jul 1988. 15p. (NASA-CR—182146; E—4171; NAS—1.26:182146). NTIS, PC A03/MF A01.

Gold based alloys, commonly used as ohmic contacts for solar cells, are known to react readily with GaAs. It is shown that the contact interaction with the underlying GaAs can continue even at room temperature upon aging, altering both the electrical characteristics of the contacts and the nearby pn junction. Au-Ge-Ni as-deposited (no heat treatment) contacts made to thin emitter (0.15 micrometer) GaAs diodes have shown severe shunting of the pn junction upon aging for several months at room temperature. The heat-treated contacts, despite showing degradation in contact resistance did not affect the underlying pn junction. Au-Zn-Au contacts to p-GaAs emitter (0.2 micrometer) diodes, however, showed slight improvement in contact resistance upon 200 C isothermal annealing for several months, without degrading the pn junction. The effect of aging on electrical characteristics of the as-deposited and heat-treated contacts and the nearby pn junction, as well as on the surface morphology of the contacts are presented.

447 **(N—88-25970) Study of Staebler-Wronsky degradation effect in a Si:H based P-I-N solar cells. Semiannual report.** Naseem, H.; Herman, A.M. (Arkansas Univ., Fayetteville (USA)). Jul 1988. 23p. (NASA-CR—182564; NAS—1.26:182564). NTIS, PC A03/MF A01.

The objective of this study is to improve the stability and efficiency of thin solar cells with emphasis on a-Si:H devices. The research project was broken down into three main phases. The first involves designing and building a UHV glow discharge system; the second involves making good quality films and eventually efficient cells; the final phase will be analytical.

448 **(N—88-26736) Analytical determination of critical crack size in solar cells.** Chen, C.P. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1988. 32p. (NASA-CR—183128; JPL-PUBL—88-10; NAS—1.26:183128). NTIS, PC A03/MF A01.

Although solar cells usually have chips and cracks, no material specifications concerning the allowable crack size on solar cells are available for quality assurance and engineering design usage. Any material specifications that the cell manufacturers use were developed for cosmetic reasons that have no technical basis. Therefore, the Applied Solar Energy Corporation (ASEC) has sponsored a continuing program for the fracture mechanics evaluation of GaAs. Fracture mechanics concepts were utilized to develop an analytical model that can predict the critical crack size of solar cells. This model indicates that the edge cracks of a solar cell are more critical than its surface cracks. In addition, the model suggests that the material specifications on the allowable crack size used for Si solar cells should not be applied to GaAs solar cells. The analytical model was applied to Si and GaAs solar cells, but it would also be applicable to the semiconductor wafers of other materials, such as a GaAs thin film on a Ge substrate, using appropriate input data.

449 **(NEI-SE—25) [Research in fuel technology - Energy research 1987-1990. Wood, peat energy plantation] Domestic fuels - Research program 1987-90. Wood, peat, energy plantation.** (Statens Energiverk, Stockholm (Sweden)). 23 Mar 1988. 47p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755059/JAW.

The report describes the National Energy Administration research and development plans for the three-year period in the field of domestic fuels - wood, peat, and energy plantation, i.e. energy forests and straw. Plans of the present type should above all be perceived as a presentation of the general aim and direction of the activities. (G.B.).

450 **(NLVF/S—641) First-time thinning, i.a. for energy purposes. Final report.** Stenhammer, E. (Norsk Inst. for Skogforskning, Aas). (Norges Landbruksvitenskapelige Forskningsraad, Oslo). Feb 1986. 14p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755061/JAW.

The report deals with a project on the first-time thinning of woodland for enrgy purposes. The aim of the project was to develop working methods in the thinning stand comprising an analysis of the cutting and collection methods, and the transport and processing of thinnings. An evalution of the organization of working procedures and the quality assessment of the thinning results are added. New approaches are briefly considered. 8 drawings, 4 tables.

451 **(PB—88-237250/XAB) Industry-wide studies report, visit to Sandia Laboratory, solar photovoltaics demonstrations.** Briggs, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 8 Dec 1978. 5p. (IWS—68.13). NTIS, PC A02/MF A01.

A visit was made to the Sandia Laboratory to investigate possible occupational hazards from photovoltaic (PV) systems. A full range of solar PV products were under consideration for all major potential markets. Concern was voiced about potential electrical hazards. Potential problems arising from electromagnetic interferences from PV power facilities interfering with radio communications on planes were considered. The production of microwaves appeared very low. Protection must be provided against lightning and hail storms. In a consideration of energy-storage systems, concern was voiced over the use of lead-acid batteries and their potential explosion problems. The possibility of operators getting in the path of concentrated sunlight from concentrator systems must be carefully avoided. Lens warpage could add to these problems and changes in the annealing cycle of the lens by doming the lens were being considered. For home applications, PV systems were under consideration which would operate in parallel with utility grids. Potential hazards associated with particular cells must also be considered.

452 **(SAND—88-0487C) Reliability testing of cell assemblies for photovoltaic concentrator modules.** Chiang, C.J.; Blankenau, S.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 14p. (CONF-880965—16). NTIS, PC A03/MF A01. Order Number DE89001379/JAW.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

Reliability testing is crucial to the design of improved cell assemblies and to the assessment of their reliability. Thermal cycling has proven to be the most difficult reliability test for cell assemblies to survive. This paper describes correlation of artificial thermal cycling with field operation through two separate experimental investigations. The first was a study of two sets of identical cell assemblies; one used in the field and the other stored. The degradation mechanism was cracking in the solder attaching the feet of the top contact to the cell. For this failure mechanism and this type of cell assembly, 125 thermal cycles of a type specified by our qualification test were found to cause the same amount of degradation as 4.7 years of use in the field. The second investigation, currently in progress, involves thermal cycling at temperatures simulating field operation but at higher cycling frequencies. By comparing identical parts cycled at different frequencies, the effect of frequency on rate of degradation can be determined. Then, a number of thermal cycles at a higher frequency can be related to an equivalent number of thermal cycles at the lower frequencies encountered in actual use. 5 refs., 3 figs., 1 tab.

453 **(SAND—88-0488C) Design of cell mounts for photovoltaic concentrator modules.** Chiang, C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 16p. (CONF-880965—14). NTIS, PC A03/MF A01. Order Number DE89001361/JAW.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

Cell assembly design involves optimization, materials selection and evaluation, fabrication processes, and assembly procedures.

The objective of the work described in this paper is the development of cell assemblies with high efficiency, improved reliability, and low cost. Specific topics discussed include optimization of cell assemblies, selection and evaluation of adhesives and insulators, fabrication methods, and assembly procedures. Important advances in soldering and reliability are reported and the cell assembly for the Sandia Baseline Module III is described. 10 refs., 1 fig., 1 tab.

454 **(SAND—88-0527C) A self-aligning photovoltaic array tracking controller.** Maish, A.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880965—12). NTIS, PC A02/MF A01. Order Number DE89001359/JAW.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

Sandia National Laboratories is developing a low-cost tracking controller for photovoltaic concentrator arrays which is designed for use in commercial fields. The system achieves a powerful yet flexible control capability by using a commercially-available microcontroller. It uses an open-loop control algorithm that eliminates the need for a sun sensor, and it performs its own initial alignment using the array output, minimizing installation manpower. The system is expected to achieve a tracking accuracy of better than +-0.15{degree} on an array with little backlash. 12 refs., 5 figs., 3 tabs.

455 **(SAND—88-0552C) Sandia's Baseline 3 photovoltaic concentrator module.** Richards, E.H. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880965—15). NTIS, PC A02. Order Number DE89001360/JAW.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

Sandia has recently designed a new photovoltaic concentrator module, the Sandia Baseline Module 3 (SBM3). The SBM3 is intended to be a high-efficiency-module (our goal is 20%) that can readily be adapted for commercial production. It consists of a 2 by 12 parquet of lenses arranged with 24 cells in an aluminum housing. The geometric concentration is 185. The cells were designed at the University of New South Wales and have a prism cover designed by ENTECH. The module features a new concept in cell assemblies in that the cells are soldered directly to a copper heat spreader, eliminating the expensive ceramic wafer that has been used in previous designs. The aluminum housings are anodized and electrophoretically coated with a high-temperature acrylic, creating a thin (50 μm) electrically isolating layer capable of withstanding 3000 volts. No additional electrical insulation between the electrically-live heat spreader and the housing is required, thereby enhancing heat transfer and, in combination with the copper heat spreader, eliminating the need for a separate (expensive) heat sink. 7 refs., 4 figs., 2 tabs.

456 **(SAND—88-0631C) 28% efficient GaAs concentrator solar cells.** MacMillan, H.F.; Hamaker, H.C.; Kaminar, N.R.; Kuryla, M.S.; Ristow, M.L.; Liu, D.D.; Virshup, G.F.; Gee, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880965—23). NTIS, PC A02/MF A01. Order Number DE89001681/JAW.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

AlGaAs/GaAs heteroface solar concentrator cells which exhibit efficiencies in excess of 27% at high solar concentrations (>400 suns, AM1.5D, 100 mW/cm²) have been fabricated with both n/p and p/n configurations. The best n/p cell achieved an efficiency of 28.1% around 400 suns, and the best p/n cell achieved an efficiency of 27.5% around 1000 suns. The high performance of these GaAs concentrator cells compared to our earlier high-efficiency cells was due to improved control of the MOCVD growth conditions and improved cell fabrication procedures (gridline definition and edge passivation). The design parameters of the solar cell structures and optimized grid pattern were determined with a realistic computer modeling program. An evaluation of the device characteristics and implications regarding future GaAs concentrator cell development is presented. 12 refs., 8 figs.

457 **(SAND—88-7030) The development and verification of the Perez diffuse radiation model.** Perez, R.; Stewart, R.; Seals, R.; Guertin, T. (Sandia National Labs., Albuquerque, NM (USA); State Univ. of New York, Albany (USA). Atmospheric Sciences Research Center). Oct 1988. Contract AC04-76DP00789. 171p. NTIS, PC A08/MF A01. Order Number DE89002469/JAW.

The purpose of this work was to determine site specific coefficients (within the US) for use with the Perez diffuse irradiance model. The model predicts diffuse irradiance on tilted planes of any orientation for all insolation conditions, based on the knowledge of direct and global (or diffuse) irradiance. This is a component of SNLA's photovoltaic simulation program PVFORM. The model consists of (1) a pre-set geometric framework that describes the main non-isotropic features of sky radiance--circumsolar and horizon/zenith effects--and (2) an experimentally derived component that describes the variations of these anisotropic effects with weather conditions. A measurement program was initiated to provide the data necessary for (1) deriving the model's experimental component for several US locations, (2) comparing model configuration and evaluating performance at these locations and (3) evaluating site dependency and recommending, if justified, model configurations adapted to particular environments/climates. Five environmentally distinct sites were selected based on their potential impact on model performance. In addition, work was performed to improve sky condition parameterization and eliminate all unjustified complexities of the original model. The main results of this work are the following: (1) the model algorithm has been greatly simplified while conserving original accuracy, (2) the physical soundness and effectiveness of the insolation parameterization method have been improved, (3) one unique model, with a fixed set of coefficients, has been shown to be sufficiently accurate to describe sites within the US. 22 refs., 19 figs., 14 tabs.

458 **(SERI/TP—211-3401) Overview of the US experience with photovoltaics in developing countries.** Surek, T.; Jones, G.J.; Annan, R.H. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1988. Contract AC02-83CH10093. 15p. (CONF-8806247—1). NTIS, PC A03/MF A01. Order Number DE88001197/JAW.

From International workshop on renewable energy in developing countries; Kiryat Anavim, Israel (12 Jun 1988).

Recent advances in photovoltaic technology, the result of a US Department of Energy program in partnership with industry, universities, and utilities, are described. An overview is given of the current and projected markets for photovoltaics. The discussion of the technology and markets sets the stage for the primary subject matter of the paper, which is the discussion of the US experience with photovoltaics in developing countries. Thousands of photovoltaic systems worldwide are providing reliable, cost-effective electrical energy in remote applications such as telecommunications, water pumping, and vaccine refrigeration. 16 refs., 12 figs., 2 tabs.

459 **(SLU-IVL—193) Measuring of dry matter content in tree sections wintertime at Loevholmen's and Karlsborg's mills.** Blomqvist, H. (Linkoeping Univ. (Sweden). Dept. of Mathematics). 1987. 64p. (In Swedish). NTIS (US Sales Only), PC A04. Order Number DE88755069/JAW.

To-day the merchant measure for tree sections is mainly ton dry matter content. Bore samples are taken from the stacks of tree sections for determination of dry matter content. The occurrence of large amounts of snow and ice in the tree sections has caused discussions as regards the estimation of the dry matter content. The purpose with this study was, primarily to verify if the dry content tests in wintertime are impaired by systematic errors and also to show if the distribution between boresamples within the stack is greater in bigger stacks containing snow and ice than in those free of snow. The results show: -the distribution of dry matter content between bore samples within the stack is greater in winter than during the bare-ground period and that the number of bore samples should be larger in winter if the same accuracy is to be obtained as during the bare-ground period. -no systematic errors exist which are statistically significant (95% level) in the estimation of the amount of dry content in wintertime, when the experiment connected errors are considered. There is however a tendency to over-estimate the amount of snow by the bore sampling method and due to

this under-estimate the amount of dry matter content. The results testify that: -the amount of snow and ice is greater in tree sections of small dimension than in large-sized. -in winter the drilling steel should be sharp so that the correct amount of wood is represented in the dry content samples as re-cuts with the borer must be avoided. Any relation clearly indicating the type of tree sections in which the dry content samples can be impaired by possible systematic errors and why the suggested deviations are greater at Loevholmen than at Karlsborg have not been provable.

460 **Backside hydrogenation technique for defect passivation in silicon solar cells.** Sopori, B.L. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401). *Journal of Applied Physics;* **64**: No. 10, 5264-5266(15 Nov 1988).

A novel technique is described for confinement of hydrogen in silicon solar cells during a high-temperature process. It is shown that hydrogen implanted at low energies on the backside of a solar cell can be confined within the cell through a metallization process consisting of deposition of aluminum and a subsequent alloying. The alloying of aluminum is done by a rapid optical processing technique. The passivation effects of hydrogen are identified in terms of improvements in the cell parameters of small area solar cells. It is shown that if the processing is done without the aluminum cap, the hydrogen is driven out of silicon with no passivation effects. This method can render hydrogen passivation compatible with standard solar cell process techniques.

461 **Ambipolar diffusion length measurements on hydrogenated amorphous silicon p-i-n structures.** Balberg, I.; Delahoy, A.E.; Weakliem, H.A. (The Racah Institute of Physics, The Hebrew University, Jerusalem 91904, Israel). *Applied Physics Letters;* **53**: No. 20, 1949-1951(14 Nov 1988).

The determination of the ambipolar diffusion length within the i layer of a p-i-n structure made of hydrogenated amorphous silicon is reported for the first time. It is shown that this important parameter can be determined by measurements carried out on the entire structure. One finds for a typical cell structure that the measured diffusion length is 10—20% smaller than the true i-layer value.

462 **Solution processes in photoelectrochemical cells.** Winnick, J.; Lessner, P.M.; McLarnon, F.; Cairns, E.J. (Georgia Institute of Technology, Atlanta, Georgia 30332). *Applied Physics Letters;* **53**: No. 20, 1985-1987(14 Nov 1988).

The simplicity of construction of a photoelectrochemical cell (PEC) as compared with solid-state devices, combined with thin-film deposition technology, offers the potential for low-cost direct energy conversion. PEC's utilizing cadmium chalcogenide photoanodes in alkali polysulfide solutions have shown sustained efficiency of solar-to-electric conversion over 12%. While the composition of the solution has been known for several years to have a remarkable effect on performance, the chemical and electrochemical processes involved remained obscure. We report here the result of a series of quantitative electrochemical experiments which show the species controlling the rate of hole-induced oxidation is disulfide, S/sup 2-/$_2$, whereas that controlling the reduction at the counterelectrode is the supersulfide ion, $S^-{}_2$, the product of the disulfide oxidation.

463 **Forest ecology.** Kimmins, J.P. New York, NY; Macmillan Publishing Company (1987). 531p. Macmillan Publishing Co., 866 Third Ave., New York, NY 10022 $48.75.

From review J.M. Kelly, Tennessee Valley Authority, in J. Environ. Qual., Vol. 17, No. 1 (1988).

This book presents the study of ecosystem ecology in the forest management context and provides a framework from which ecological concepts can be applied to day-to-day forest management activities. The book is divided into three major parts. Part I discusses the demands placed on the forest by increased population growth. Part II is divided into five sections: ecosystem function, genetic and evolutionary aspects of ecosystems, physical factors, biotic factors and ecosystem changes. Part III contains three chapters dealing with classification systems, the application of mathematical models and the philosophy of resource management in the ecosystem context.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 434, 435, 436, 437, 438, 439

464 **(AFME—84-2185) Range of photovoltaic pumps driven by an asynchronous motor.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 24p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755318/JAW.

The aim of this work was to develop a prototype inverter with variable frequency and according follow-up of the maximum power point of a photovoltaic panels field. The inverter will be used by a whole range of photovoltaic pumps driven with an asynchronous three-phase motor. The power rating of the inverter is 2500 Wc (input), corresponding to a shaft power of 1.5 kw.

465 **(AFME—84-9271) Desalination of briny water by reverse osmosis in a solar unit driven by a photovoltaic generator in El Hamrawein (Egypt): technical design and performances.** Vanderborre, C. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1987. 43p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755319/JAW.

A reverse osmosis desalination unit has been developed and tested in Egypt. The water production rate is 55 m/sup 3/ per day; it is driven by two photovoltaic generators (18 kw power peak) PHOTOWATT. The energy consumption of the unit is less than 1 kwh per m/sup 3/ of fresh water. The economic efficiency of the system is analysed.

466 (ESA-SP—267, pp 131-136) **High power solar array technologies.** Behrens, G. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Potential high power solar arrays for the Columbus programme have been investigated with regard to critical technologies needed for their electrical parts. The investigations and assessments for definition of technology items where specific problems exist and further work is necessary are described. Main problem areas are the harness concept, manufaturing and high voltage and environmental aspects. The results will flow into a detailed high power solar array technology development and test programme.

467 (ESA-SP—267, pp 151-160) **Fokker strongback solar array.** Zwanenburg, R. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The Strongback Array (STAR) in combination with rigid solar panels offers an attractive design solution for the high power levels up to 40 KW. The strongback array deploys the panels simultaneously in a synchronized way. The deployment is actuated by deployment springs. Deployment control and retraction is possible. High strength and stiffness in deployed condition is obtained by the preloaded truss-type structure. A life size model of 9 m length is built to demonstrate the performances.

468 (ESA-SP—267, pp 161-170) **MARECS and ECS anomalies attempt for insulation defect production in kapton.** Levy, L.; Reulet, R.; Sarrail, D.; Siguier, J.M.; Lechte, H. (Centre National d'Etudes Spatiales, 31 - Toulouse (FR)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The paper reports on experimental investigations on solar array samples with the objective to reproduce the short-circuits assumed to be responsible for the ECS and MARECS in-orbit power losses. Discharges were produced between the interconnects and the cover-slides according to the inverted gradient voltage concept

in presence of the solar array voltage. We assessed the theory that such low voltages could maintain an arc, leading to a permanent short-circuit, burning away the Kapton, provided the discharge be triggered by a higher voltage. It was not possible to produce any permanent insulation defect through the insulation Kapton layer. The discharges by themselves are clearly not sufficient to produce the failure. Something more, or something else has to be assumed, associated (or not) with the discharge.

469 (ESA-SP—267, pp 171-174) **Micrometeorite impact on solar panels.** Schneider, E. (Fraunhofer-Institut fuer Kurzzeitdynamik, Freiburg (DE)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Short circuits have been detected in the solar panels of several ESA-telecommunication satellites (e.g. Marecs A). Micrometeorite and space debris impacts are considered as one of the possible causes. Therefore, a micrometeorite simulation program has been initiated to study damage phenomena and failure mechanisms of solar panels under hypervelocity impact conditions. A first experimental study demonstrated that transient as well as permanent short circuits can be produced by particle impact. Even arc discharges can be initiated under realistic electrical power conditions. There is evidence that failures caused by impact induced short circuits can be minimized by approving the geometrical arrangement of the panels and by optimizing the electrical circuitry.

470 (ESA-SP—267, pp 175-180) **Micrometeorite exposure of solar arrays.** Weishaupt, U.; Kuczera, H.; Rott, M. (Technische Univ., Muenchen (DE). Lehrstuhl fuer Raumfahrttechnik). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The occurrence of permanent losses of a part of the available power on solar arrays of ESA satellites may be caused by micrometeoroid or space debris impacts. Therefore, hypervelocity impact simulation has been performed at the Munich Plasma Accelerator Facility using ECS and OLYMPUS solar panel structures. The experimental results have confirmed that significant damage of the solar arrays can be caused by small hypervelocity particles. Using a Solar Array Simulator connected to the test sample, penetration phenomena as well as arc triggering effects have been investigated within the efficiency range of the accelerator.

471 (ESA-SP—267, pp 181-188) **Anomalies observed in plasma-module-interaction experiments.** Thiemann, H.; Dharma Rao, P.V. (Physikalisch-Technische Studien GmbH (DE)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

We present results on plasma-module-interaction experiments in a simulated low earth orbit plasma. Local ionization of the neutral backgroundgas appears to result in a very efficient plasma shielding of the biased interconnectors with small sheath dimensions. The discharging processes on the dielectric solar cell cover glass surfaces therefore are not influenced by the strong electric fields near the interconnectors. Only for sufficient large module voltages (typically 200 V) the plasma sheath reaches the dielectric parts and the processes around the various parts of the module mutually interact, causing anomalies in the interaction.

472 (ESA-SP—267, pp 189-196) **Stopping differential charging of solar arrays.** Lechte, H.G. (European Space Research and Technology Centre, Noordwijk (NL)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Assuming that the build up of electrostatic charge on solar arrays of geostationary satellites is a contributing factor in reducing the lifetime of vital insulators, the mechanism of charging the various elements of a rigid solar array has been analysed and means proposed to reduce differential charging. Those include avoidance of charging the array rear, a better matching of secondary emission yields between both faces of the array or the provision of an electrical leakage path between cover slips and solar cells to bleed off any charge. It is advised that the design of solar generators for geostationary missions takes seriously into account the build up of electrostatics and provides for sufficient precautions against resulting stresses, including those from micrometeorites.

473 (ESA-SP—267, pp 373-376) **Solar generator for spectrometer power supplying on mission Phobos.** Ojanen, P.; Olsen, S. (Technical Research Centre of Finland, Espoo (FI); Kiruna Geophysical Inst. (SE)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

ASPERA is a scanning cosmic plasma analyser to fly on board spacecraft Phobos which will be launched towards Mars and Martian moon Phobos in 1988. Since the available power from the spacecraft is limited, the instrument has a small solar generator to produce extra power and so to maximize the operational time of the instrument. A brief description of the mission Phobos and instrument Aspera is presented. The solar generator of Aspera will be covered in more detail.

474 (ESA-SP—267, pp 387-390) **Solar array plasma interaction experiment - spie bifacial cell technology calibration experiment - BCC Planned Inorbit Experiments.** Bebermeier, H. Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Interactions of large solar arrays in the low earth orbit with the surrounding environment define main design elements and constraints. For solar array voltages above 200 Volts increased electrical phenomena with the ionospheric plasma have been observed in simulated plasma tests on earth. The paper describes an experiment proposal for a flight verification of high voltage solar arrays. The proposed experiment configuration can also be used with an optical sensorsystem for the measurement of the Albedo flux. Exact Albedo-values are required for the bifacial solar array technology.

475 (ESA-SP—267, pp 425-432) **Energy dependence of proton irradiation damage in GaAs solar cells and effects of combined radiation on them.** Takata, N.; Matsuda, S.; Gomi, J.; Toriyama, K.; Goto, M.; Hokuyo, S. (National Space Development Agency, Tokyo (JP); Mitsubishi Electric Corp., Tokyo (JP)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

This paper describes energy dependence of proton irradiation damage in GaAs solar cells and effects of combined radiation on them. Energy dependence of proton irradiation damage which was obtained by exposing GaAs solar cells to protons over the energy range of 0.05 {similar←to} 15 MeV is described. In particular, relative damage coefficients are shown as a function of proton energy and fluence. Furthermore, effects of combined radiation on GaAs solar cells are discussed; the degradation characteristics of GaAs solar cells which have also been exposed to protons with different energy or electrons in addition to protons above are evaluated through the degradation calculations on the basis of conventional method. This paper also addresses a new method which is considered to be more useful for estimating degradation of solar cells by combined radiation than the conventional one.

476 (ESA-SP—267, pp 433-436) **Radiation damage in GaAs and ultrathin Si solar cells due to low energy electrons.** Matsuda, S.; Tsuji, M.; Mitsui, H.; Tanaka, R.; Sunaga, H.; Takasaki Radiation Chemistry Research Establishment). (National Space Development Agency, Tokyo (JP); Japan Atomic Energy Research Inst., Takasaki, Gunma). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

In this paper, we mention about the experimental results that low energy electron irradiate to GaAs and ultrathin Si solar cells. We prepared GaAs(280μm) and ultrathin Si (50μm) cells as samples and irradiated them to electron over the energy range of 0.3 MeV - 3.0 MeV. Using these results, we derived the relative damage coefficients reffering to normal incident 0.92 MeV electron on bare cell. This result shows shield effect of cover glass in low energy. Then we exposed solar cells to Co-60 gamma ray and obtained the relation between gamma ray dose D and electron fluence PHI. We assumed the relational equation PHI = aD/sup b/ and obtained the coefficients a,b. In the result, coefficient a depends on the electron energy and b is nearby equal to 1.

477 (ESA-SP—267, pp 437-442) **Development of a mobile pulsed solar simulator.** Wharf, J.H.; Davies, M.A.H.; Roe, P.J. (Royal Aircraft Establishment, Farnborough (GB)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

This paper describes the design, construction and performance of a comparatively lightweight mobile pulsed solar simulator which is for the measurement of solar array performance during Spacecraft envionmental testing. To provide constant light intensity over the measurement period, the flash tube is powered from a 4 stage capacitive/inductive pulse forming network. The predicted and achieved performance from this network is compared and data showing the variation of intensity with time presented. The results obtained with this simulator have been found to be in good agreement with those obtained using the ESTEC large area pulsed solar simulator.

478 (ESA-SP—267, pp 443-462) **Setting-up of SPASOLAB.** Sanchez, E.; Gras, A.M. (Instituto Nacional de Tecnica Aerospacial, Madrid (ES)). Nov 1986. NTIS (US Sales Only), PC A21/MF A01. Order Number DE89780015/JAW. (CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

This paper summarizes the work carried out under Phase 1 of the SPASOLAB project, founded by ESA. The objective of this project is to install at INTA (Spain) a laboratory to test and qualify solar cells for space applications. In this paper, the generic requirements on the equipment to be installed at SPASOLAB and the particular characteristics of the equipment selected to be included at SPASOLAB are described. The main guidelines for the incoming Phases 2 and 3 of the SPASOLAB project are briefly mentioned as well.

479 (SAND—88-0636C) **Practical application of the National Electrical Code to photovoltaic system design.** Key, T.; Menicucci, D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880965—10). NTIS, PC A03/MF A01. Order Number DE89000506/JAW.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

Photovoltaic (PV) power systems involving "premises wiring" usually must meet the requirements of the National Electric Code (NEC). This is often difficult or uneconomic because PV standard design practices, and in some cases, the required dc-rated hardware, are not readily available. This paper focuses on problems in applying the NEC to PV system design and installation. Generic design requirements are discussed, including dc collection, ground-fault detection, disconnection and switching. A dc-service panel concept is introduced as a practical approach to meeting both NEC and functional design requirements. A sample design, and economic assessment are provided to support this concept. 5 refs., 6 figs., 2 tabs.

1407 Solar Thermal Power Systems

480 (AFME—84-0308-1) **Vignola solar power plant. Test results.** Marques, M.; Bonifay, P.; Simonnot, G. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 149p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755317/JAW.

The two-years field test results at the Vignola (France) solar power plant are presented. The overall material behaviour is good and the mirror deterioration (observed in the early periods) is stabilized. The boilers, meanwhile, have been deteriored and are responsible for a large part of the (low) reduction of the performances. The heat storage design is well adapted but a new design is proposed: a stratified thermal capacity that would be dimensioned to delete the cloud passage effects or to start up the auxiliary heat source (fuel, gas, coal, ...).

481 (BFR-R—87-1987) **Parabolic solar collectors in Sweden. Performance and potential.** Johansson, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 37p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755036/JAW.

A newly developed linear parabolic solar heater has been tested in Stockholm, Sweden. At the occasion the absorber was horisontally installed in an east/west direction. Other alternative installations with higher degree of following the sun are possible. Computer calculations are being made for different cases for solar heater areas with varying degree of ground coverage. A case where the mirrors have a fixed tilt to the vertical axis of rotation has been investigated. Caiculations show that the average yield over the year in a climate of Stockholm's character ought to be about 500-600 kWh (at an operating temperature of about 80 degrees C) which is very high. The initial costs for a solar heater area for about 2000 sq.m of solar heaters are at a threefold yearly production volume about SEK 1500-1700/sq.m. At a considerably greater production volume the lowest cost barrier is calculated to about SEK 1200/sq.m. (L.F.).

482 (DOE/CE—0233) **Bringing solar thermal technology to the marketplace: A report to the US Congress.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC). Aug 1988. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015523/JAW.

This report describes the significant progress already made in bringing solar thermal energy systems to the marketplace and the prospects for continued private sector market development. The report is organized in three sections. The first section, Solar Thermal's Potential, reviews the need for developing solar thermal technology and the payoffs resulting from its utilization. The next section, Solar Thermal Research & Development, discusses the solid technology base that has been established and the current emphasis of R & D efforts. In the third section, Progress in Commercial Applications, success in bringing first-generation solar thermal systems to the marketplace is reviewed and processes and prospects for continued market development are outlined. 9 refs.

483 (N—88-25977) **Advanced heat receiver conceptual design study. Final report, July 1986-November 1987.** Strumpf, H.J.; Coombs, M.G. (AiResearch Mfg. Co., Torrance, CA (USA)). Dec 1987. 327p. (NASA-CR—180901; NAS—1.26:180901; AIRESEARCH—87-61069). NTIS, PC A15/MF A01.

A study was conducted to generate and evaluate advanced solar heat receiver concepts for orbital application with Brayton and Stirling engines approximately 7 kWe in size. The resulting designs have thermal storage capability, and will be lighter, smaller, and/or more efficient than baseline systems such as the configuration used for the Brayton solar receiver currently under development by Garrett AiResearch for the NASA Space Station.

484 **(SAND—88-1210) A comparison of the performance/economics of thermochemical and sensible energy transport for distributed receiver solar thermal systems.** Muir, J.F. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DP00789. 66p. NTIS, PC A04/MF A01. Order Number DE89001842/JAW.

A major challenge facing the development of distributed receiver solar systems is the efficient transport of high-temperature thermal energy from the collectors to the point of use. As receiver temperatures increase, conventional sensible energy transport methods become less attractive because of increased heat loses and insulation costs. A promising alternative that is particularly attractive for the high temperatures characteristic of paraboloidal dishes and the extensive piping associated with large collector fields is the concept of thermochemical energy transport. Estimates of the performance and economics of four sensible and two thermochemical transport systems for a dish collector field are compared at four delivery temperatures ranging from 400 to 815{degree}C. The sensible working fluids are Sytherm 800, NaK, Li-Na-K carbonate salt eutectic, and steam. The thermochemical systems are carbon dioxide reforming of methane and dissociation of sulfur trioxide. On the basis of levelized energy cost, there is no clear choice between sensible and thermochemical energy transport at 400{degree}C. At higher output temperatures, thermochemical transport is more cost-effective and is the only viable choice at temperatures above {approximately}700{degree}C. The thermochemical system based on the carbon-dioxide reforming of methane has the best performance and lowest costs at temperatures >400{degree}C and appears closest to meeting the DOE Solar Thermal Technology Program long-term IPH goal of 3 {cents}/kWh/sub th/ (9 $/MBtu/sub th/) LEC. 29 refs., 10 figs., 5 tabs.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 722, 786

485 **(AFME—85-04-1001) Interseasonal storage of solar heat.** Gaudet, J.P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 20p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755321/JAW.

An interseasonal heat storage system with heat exchangers burried in the soil is described. The heat is produced by plane solar collectors; a buffer storage tank ensures the readiness of heat and hot water supply. It appears that 80 pc of the collected solar energy is storable in the system. A model is developed that predict the overall performances of the space heating (floor heating) and storage systems. The feasability of the system for mono-family residential house is evaluated.

486 **(BFR-R—16-1988) Group of houses connected to a seasonally solar heated storage at Saroe. Preparatory study.** Graeslund, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 43p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755015/JAW.

A newly erected building site consisting of 45 flats is described. They are to be connected to an insulated seasonally solar heated storage. By using a newly developed type of high temperature solar heaters integrated in the roof of the houses, roof area will produce about 60-70% of the yearly amount of heat needed for the buildings without using any additional ground area for solar heaters. The system is described in detail and the relation between the area for solar heaters, storage volume, storage insulation and covering power for solar heaters have been economically and technically investigated. (L.F.).

487 **(BFR-R—24-1988) Large scale solar heating technique in Sweden. System development and dimensioning.** Dalenbaeck, J.O. (Chalmers Univ. of Technology, Goeteborg (SE). Dept. of Building Services Engineering). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). Aug 1987. 185p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88755017/JAW.

A number of solar heated plants with seasonal storage have been erected in Sweden. In order to get a broad knowledge about different types of plants they have been built in different sizes and been systematically followed up. This has led to an unique amount of knowledge in this field. The aim for the experimental projects has been to act as research-, development- and demonstration objects. Research and development for solar heated storages is today on an advanced level concerning solar cells and system technique. Heat storage of building technique for uninsulated storage in rock is well established but knowledge about design and material for insulated storages is still to be developed. (With 53 refs.) (L.F.).

488 **(BFR-R—27-1988) Solar heating connected to a short time storage at Falkenberg. Preparatory study.** Claesson, T. (Scandiaconsult Vaest AB, Goeteborg (SE)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 16 Nov 1987. 22p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755018/JAW.

Heat production in the town of Falkenberg is mainly based upon wood chips and oil. To the central municipal heating system schools and building complexes are connected. The energy consumption during a normal year is calculated to a total of 25.8 MWh where losses from culverts are included. The total net effect is about 10.3 MW. The system is designed for an entry temperature of 70 degrees C during the summer period and 95 degrees C when the outdoor temperature is down to -16 degrees C. Solar heaters intended to be used are of a flat type and furnished with convection obstacles of nylon. At a 8.5% degree of solar coverage of the energy requirements there is a demand for solar heaters of 5500 square metres and a storage of 1100 cubic metres. The solar heater plant is intended to be a complement to wood chips combustion. The calculated cost for the plant is about MSEK 11.4 (October 1987) where costs are included for subcentrals, accumulators, areas for solar heaters, culverts and project planning. Return temperature during the summer period is about 60 degrees C, which is too high. In order to utilize the solar energy in an effective way the return temperature must be reduced to about 20 degrees C and there are possibilities for this but it concerns mainly the secondary system of the users. (L.F.).

489 **(BFR-R—38-1988) District heating system with solar energy contribution in Torvalla, Oestersund. Performance assessment.** Graeslund, J.; Hultmark, G. (Oestersunds Fjaerrvaerme AB, Oestersund (SE)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 41p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88755023/JAW.

A solar heating system to supply heat to a district heating system was built in Torvalla, outside Oestersund, in 1983. The total area of the array is 2088 m/sup 2/ (1702 m/sup 2/ effective collector area). Heat is used to preheat the return flow from the Torvalla district heating system. Three years' performance monitoring shows that the temperature in the district heating system is of key importance in determining the energy yield from collectors of this type, which do not incorporate anti-convection baffles, i e without insulation between the absorber and the cover glass. Since it was first built, the solar heating plant has been fitted with simplified control equipment and with other equipment intended to improve reliability of operation and to provide a higher energy yield. Measured and calculated annual efficiencies for the plant are 30%. (authors).

490 **(BFR-R—86-1987) Lyckebo project, solar district heating combined with seasonal heat storage in rock caverns.** Brunstroem, C.; Hillstroem, C.G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 30p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755035/JAW.

The accessibility for distributed energy until July 1986 to the network has been 100%. The efficiency of the solar heaters fulfil high demands and the system is up to expectations. However, the heat losses from the storage have so far been higher than expected. Different possible explanations for and actions against the losses are being investigated. (L.F.).

491 **(FRNC-TH—3345) Contribution to the study of the solar energy lines with air collectors and underground storage.** Rassafi, M. (Lille Univ., 59 - Valenciennes (France). Centre Universitaire). Jul 1986. 201p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755294/JAW.

The aim of this study was to examine the feasability of a solar space heating system for a machinery hall in the north part of France. The solar heating system is composed of an air solar collector combined to a sensible heat storage system (the soil beneath the hall). Heat transfers and thermal loads are calculated; the mathematical results are compared with experimental results.

492 **(PB—88-235411/XAB) Dynamic calibration of rapid-response thermoelectrical sensors: installation.** Serra, J.J.; Jaymes, M. (Etablissement Technique Central de l'Armement (ETCA), 94 - Arcueil (France). Centre Mecanique Chimie Materiaux). 16 Dec 1987. 37p. (In French). (ETCA—87-R-139). NTIS, PC E04/MF E04.

Characterization of the performance of sensors with not very time-constant temperatures required the development of a calibration bench. The bench was linkcd with the Odeillo Test Center's secondary solar furnace to evaluate the performance of these high-temperature sensors. After a brief review of the theory necessary to comprehend the heat phenomena involved, the report describes the calibration bench in its new installation.

493 **(SP-RAPP—1987-32) Testing of solar heating systems and components, part 1. Compilation of solar collector test results for the period 850202-860630.** Bergquist, P. (Statens Provningsanstalt, Boraes (Sweden)). 2 Jun 1987. 44p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755083/JAW.

The report comprises test results for the period between 1985 to the middle of 1986 of seven Swedish-made, water-cooled solar collectors, available on the Swedish market. The report also comprises results of tests done by the manufacturers in their own development work. The scattering in thermal performance between the collector with lowest and highest efficiency respectively is rather great, up to 60 %. A comparison is made of today's collectors and collectors available on the Swedish market in 1980-81. Today's collectors have lower efficiency by low differences collector-hot water, but an improvement is noted in the temperature region for hot water production. For the remaining testing, comprising durability to climate factors, and aging and corrosion tests on various components of the collectors, no adverse remarks resulting in non-acceptance were made. The quality level of today's Swedish-made solar collectors is satisfactory throughout. (G.B.).

494 **Performance of a solar desiccant cooling system.** Lof, G.O.G.; Cler, G.; Brisbane, T. (Colorado State Univ., Fort Collins, CO (US)). *Journal of Solar Energy Engineering;* **110**: No. N-3, 165-171(Aug 1988).

A solar desiccant cooling system was operated at the Solar Energy Applications Laboratory, Colordado State University, throughout the 1986 summer. The system comprises an American Solar King fresh air heating/desiccant evaporative cooling unit, a Sunmaster evacuated tube solar collector, hot water solar storage tank, auxiliary electric boiler, controls, and accessories. The cooling unit is operated in the ventilation mode, fresh air being dried in a rotating desiccant matrix, and cooled by heat exchange and evaporative cooling. Return air is used as a cooling medium in a rotating heat exchange matrix, heated by solar energy in a heat exchange coil, and discarded through the rotating desiccant bed. The solar-driven system provided over 90 percent of the seasonal cooling requirements in an experimental, residence type building at average COP levels of 1.0 and solar collection efficiencies of 50 percent when supplied with solar heated water at temperatures of 50 to 65{sup 0}C. Detailed operating results, including total and average solar cooling provided, coefficients of performance, and overall solar cooling performance ratios are presented.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 456, 494

495 **(N—88-25474) Design and demonstration of a system for the deposition of atomic-oxygen durable coatings for reflective solar dynamic power system concentrators. Final contractor report.** McClure, D.J. (Minnesota Mining and Mfg. Co., St. Paul (USA)). Jul 1988. 68p. (NASA-CR—4158; E—4150; NAS—1.26:4158). NTIS, PC A04/MF A01.

A system for the vacuum deposition of atomic-oxygen durable coatings for reflective solar dynamic power systems (SDPS) concentrators was designed and demonstrated. The design issues pertinent to SDPS were developed by the Government Aerospace Systems Division of the Harris Corporation and are described in NASA-CR-179489. Both design and demonstration phases have been completed. At the time of this report the deposition system was ready for coating of facets for SDPS concentrators. The materials issue relevant to the coating work were not entirely resolved. These issues can only be resolved when substrates which are comparable to those which will be used in flight hardware are available. The substrates available during the contract period were deficient in the areas of surface roughness and contamination. These issues are discussed more thoroughly in the body of the report.

496 **(N—88-25475) Thermal distortion analysis of the space station solar dynamic concentrator.** Trudell, J.J.; Dalsania, V.; Baumeister, J.F.; Jefferies, K.S. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 25p. (NASA-TM—100868; E—4090; NAS—1.15:100868; CONF-880702—). NTIS, PC A03/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

A method was developed to evaluate the thermal distortion of the Space Station Solar Dynamic Concentrator and the effects of thermal distortion on concentrator optical performance. The analytical method includes generating temperature distributions with TRASYS and SINDA models, interfacing the SINDA results with the SINDA-NASTRAN Interface Program (SNIP), calculating thermal distortion with a NASTRAN/PATRAN finite element model, and providing flux distribution maps within the receiver with the ray tracing OFFSET program. Temperature distributions, thermally induced slope errors, and flux distribution maps within the receiver are discussed. Results during a typical orbit indicate that temperatures of the hexagonal panels and triangular facets range between -18 and 99 C (-1 to 210 F), facet rotations are less than 0.2 mrad, and a change in facet radius due to thermal flattening is less than 5 percent. The predicted power loss with thermal distortion effects was less than 0.3 percent. The thermal distortion of the Solar Dynamic concentrator has negligible effect on the flux distribution within the receiver cavity.

497 **(N—88-26190) Influence of refractive index and solar concentration on optical power absorption in slabs.** Williams, M.D. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1988. 11p. (NASA-TM—4056; L—16442; NAS—1.15:4056). NTIS, PC A03/MF A01.

The optical power absorbed by a slab at the focus of a parabolic dish concentrator is calculated. The calculations are plotted versus maximum angle of incidence of irradiation (which corresponds to solar concentration) with absorption coefficient as a parameter for several different indices of refraction that represent real materials.

498 **(NEI-DK—98) Selective surfaces in solar collectors.** Andersen, N.B. (Teknologisk Inst., Taastrup (Denmark). Afd. for Varme-og Installationsteknik). 1988. 54p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755051/JAW.

This report gives a characterization of selective surfaces for use in solar collectors. The different ways to obtain the selective performance are classified. The classification used here is adapted from M. Sikkens /16/. The physical background for a selective per-

formance takes origin in the electromagnetical theory. It is the reason, why the main parameters for exchange of radiation etc. in this presentation are related to the basic parameters in the electromagnetic theory (appendix D). The report presents an overview of industrial processes and technics dominating the area of selective surface, and furthermore a table of measured values for absorptance and emittance of known surfaces is also presented. Economical conditions are introduced through a cost/benefit analysis of a solar system for hot water production installed in a traditional family dwelling. During the project period a lot of references have been collected. This collection may serve as a tool for a search on specific litterature by an interested user. 18 refs.

499 **Welding development for thin-walled solar receiver panels.** Carli, G.; Kegel, W.F.; Narayanan, T.V. (Foster Wheeler Development Corp., Livingston, NJ (US)). *Journal of Solar Energy Engineering;* **110**: No. N-3, 226-229(Aug 1988).

This paper presents the results of the work done in a project to develop the basic fabrication methods for the continuous longitudinal welding of thin-walled tubes to form flat panels for a solar receiver and for attachment of support lugs to the panels. The paper describes the stress analysis and welding development that were performed to resolve critical design and fabrication uncertainties. The work was performed in sufficient detail to develop a reliable and cost-effective thin-walled absorber panel for a commercial solar central receiver plant.

1420 Heat Storage

REFER ALSO TO CITATION(S) 483, 485, 670

500 **(AFME—83-1302) Preliminary study on a thermal energy conversion and storage electrochemical system.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 20p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755324/JAW.

An evaluation of the CASE galvanic cell with electrochemical conversion of thermal energy is presented. The two oxido-reduction reaction occuring in the cell may be represented by the following equilibrium: (1) Sn + 2Cr3+ and (2) Sn2 + 2Cr2+; from 1 to 2 the reaction occurs at high temperature and from 2 to 1 at low temperature. Open circuit potentials have been measured as a function of the temperature and the ionic concentration. Polarization curves are drawn for different operation conditions.

501 **(AFME—83-2458-1) Pilot project for energy recovery with storage in the soil.** Ferries, B.; Pauzin, S. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1984. 118p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755322/JAW.

A space heating system for a residential building with interseasonal heat storage is described. The heat is produced bu solar collectors and by a heat pump with the Canal du Midi as the cold source; the aquifer and the soil near the building are used as heat storage through vertical heat exchangers. A simulation model has been developed and is used to predict the performances of the system and to compare its efficiency with a standard solution (heat pump and a boiler).

502 **(AFME—84-0097-7) Study of heat transfer between a gaseous fluid and an embedded thermal storage material with phase transition.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 19p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755325/JAW.

The thermal behaviour of a spheric encapsulated phase change material heat storage system with hot air supply is studied experimentally and analytically. Three modelization methods are developed and their results are compared: an equivalent storage temperature method, a simplified regression method and general regression method. The global behaviour of the exchanger is poorly described by the first method; the second method is well adapted to fixed bed exchangers while the third method is more adapted to phase change material exchanger - storage systems.

503 **(AFME—84-0548) Experimentation of a heat storage in a fissured aquifer medium.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 40p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755323/JAW.

In the Paris region, 80 pc of the potential sites for industrial thermal effluent storage are situated in fissured aquifer grounds. An experimental storage system have been realized in such a site and many data have been collected. The thermal behaviour of the site is examined and a model have been developed. The measuring technique is also described. The conclusions are positive.

504 **(BFR-R—6-1988) Water flow in a borehole heat storage.** Aaberg, B.; Johansson, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 83p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755013/JAW.

This project concerns development of methods to calculate exchange of water between drill holes in so called open drill holes systems and ambient rock. The methods are partly for fissured rock and partly for rock with a marked crack or crushed zone. Calculations for three-dimensional flow in fissured rock points out that water leakage from the store is unsuitably great if the hydraulic conductivity of the rock exceeds a value K=1.0x10/sup -6/ to 3x10/sup -6/ cubic metres per second and square metre. Preliminary calculations for a single large crack transversing the storage show that the waterleakage is unsuitably large if the width of the crack exceeds 0.4mm. It appears that transversing cracks ought to be cement injected within and around the storage. (L.F.).

505 **(FRNC-TH—2852) Contribution to theoretical and experimental study of long term soil beat storage systems.** Muangnapoh, T. (Toulouse-3 Univ., 31 (France)). 1984. 146p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755308/JAW.

A long term heat storage system for passive solar houses (with a greenhouse) is studied both analytically and experimentally. The storage system is composed of a duct lattice buried in the soil under and around the house, by which the hot air from the greenhouse is transferred and stored in the soil. A model is proposed with parameters such as duct number, depth and geometry, or heat loss, etc. The model is modified, after experimental verification, in order to take into account the water mass transfer in the soil.

506 **(FRNC-TH—3276) Characterization of porous media in order to store thermal energy in house wall active systems.** Benlamlih, R. (Perpignan Univ., 66 (France)). 1986. 111p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755309/JAW.

The heat transfers in granular and alveolar media are studied experimentally and analytically through a computer simulation. The thermal behaviour of a medium composed of stacks of phase change material spheres (paraffin and choliarolithe) with a hot air flow is analysed together with the thermal behaviour of concrete. Differences appear between experimental and simulation results for concrete; a humidity mass transfer parameter is then introduced. At last, the heat and mass transfers in a composite medium (concrete - phase change material - concrete) are studied.

507 **(FRNC-TH—3285) Inter-seasonal solar energy storage in underground quarries for residential purposes.** Efforsat, J. (Paris-6 Univ., 75 (France); Ecole Nationale Superieure des Mines, 75 - Paris (France)). Apr 1983. 193p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88755300/JAW.

A theoretical study through mathematical simulation has been conducted in order to evaluate the thermal behaviour of a seasonal heat storage system in underground pits. The temperature evolution and thermal transfers in the soil are modelized in and around the quarry filled with hot water. It appears that the thermal load is well preserved but the output temperature when the water is recuperated is too low to allow direct utilization. A heat pump is still suitable.

15 GEOTHERMAL ENERGY

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 503

508 **(LUND-MPH—87-13) Thermal analysis of heat extraction boreholes.** Eskilson, P. (Lund Inst. of Tech. (Sweden). Dept. of Mathematical Physics). 19 Aug 1987. 81p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755050/JAW.

The ground is a virtually unlimited, always accessible heat source and sink to heat pumps. One or many deep boreholes may be used as heat exchanger in the ground. The thesis presents a reasonably complete theory for the thermal processes in ground and boreholes.

1520 Geothermal Data And Theory

509 **(DOE/ER/13228—T2) Mechanical properties of rocks at high temperatures and pressures: Final report.** Friedman, M.; Bauer, S.J.; Chester, F.M.; Handin, J.; Hopkins, T.W.; Johnson, B.; Kronenberg, A.K.; Mardon, D.; Russell, J.E. (Texas A and M Univ., College Station (USA). Research Foundation; Texas A and M Univ., College Station (USA). Texas Engineering Experiment Station). 27 Jul 1987. Contract FG05-84ER13228. 189p. NTIS, PC A09/MF A01. Order Number DE89001780/JAW.

During the final year of the grant, we have investigated (1) why the strengths of rocks decrease with increasing temperature and in the presence of water through study of the fracture process in Westerly granite and Sioux quartzite specimens deformed in extension (some in true tension), (2) frictional strengths of rocks at high temperatures, (3) the stability of boreholes in fractured rock, and (4) slip in biotite single crystals (in that biotite is probably the weakest and most ductile of the common constituents of crystalline rocks.

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

510 **(STEV-NYEL—88-5) Wave data from Swedish coastal waters 1986.** Svensson, J.; Wickstroem, K. (Statens Energiverk, Stockholm (Sweden)). 1987. 50p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755089/JAW.

Wave measurements have during 1986 been carried out at seven sites at the Swedish coast. Four stations are permanent. Two is mobile and has been used for measurements for six to twelve months at the sites Vaederoearna, Hoburgen and Laholmsbukten. This year measurements were carried out at Oestergarn and Vaederoearna. The report presents plottings of wave data, and mean wave power for different wave periods. The duration of storms and of calm periods is also presented. (authors).

17 WIND ENERGY

REFER ALSO TO CITATION(S) 2672

511 **(STEV—1988-R3) IEA Large-scale wind energy. Annual report 1987.** (Statens Energiverk, Stockholm (Sweden)). 1987. 120p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755085/JAW.

The report reviews the progress during 1987 within the Agreement for Co-operation in the Development of Large-scale Wind Energy Conversion Systems, operated under the auspices of the International Energy Agency. The installation of government-sponsored large-scale (> 500 kW) wind systems almost doubled during 1987 to more than 50 MW. The systems include single large-scale wind turbines and windfarms of small and medium-sized machines. Commercial large-scale wind turbine installations, dominated by windfarms in the USA, are not included. By the end of 1987 the cumulative installed Californian windfarm capacity was more than 1500 MW, representing about 16000 units. The windfarms generated about 4 TWh of electricity from 1981 to the end of 1987. Several machines and farms are operated at over 95 percent availability.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 688

512 **(RISO-M—2717) 55/30 KW experimental wind/diesel system at Risoe National Laboratory.** Lundsager, P.; Noergaard, P. (Risoe National Lab., Roskilde (Denmark)). Aug 1988. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755065/JAW.

As part of the Wind/Diesel programme at Risoe National Laboratory an experimental Wind/Diesel system has been developed and implemented. The system includes a standard 55 KW Bonus wind turbine and a 30 KW diesel generator set, modified with a clutch and a flywheel. The system has been in experimental operation since early 1985 while at the same time a commercial development of Wind/Diesel systems has been underway in Denmark, to a considerable extent based on the concepts of Risoe's experimental system. The paper describes the basic principles and philosophy of the system, and theoretical and experimental results on the system are presented. The system concept is evaluated, and the impact of the features of the system on commercial system design and performance is discussed. 12 refs.

513 **(SAND—88-0916C) VAWT [Vertical-Axis Wind Turbines] stochastic loads using a 3-D turbulence simulation.** Homicz, G.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880916—2). NTIS, PC A03/MF A01. Order Number DE89001371/JAW.

From 18. national conference of the American Wind Energy Association; Honolulu, HI, USA (19 Sep 1988).

The stochastic (i.e., random) aerodynamic loads created by atmospheric turbulence are thought to be a primary cause of premature blade fatigue in Vertical-Axis Wind Turbines (VAWTs). This paper describes a computer program for the prediction of these stochastic loads, based on a full 3-D simulation of the turbulence field. Computed results using this model are compared with the deterministic (periodic) loads which occur in the absence of turbulence, and with the predictions of an earlier model which employed a 1-D simulation of the turbulence. The results show that not only are instantaneous loads significantly influenced by turbulence, but that load distributions averaged over numerous revolutions are affected as well. A particularly interesting finding is that, for the same mean wind speed, the average output power is altered by turbulence. 16 refs., 6 figs., 1 tab.

514 **(STEV-VIND—88-2) Blade experience Maglarp. Design/manufacture/operation.** Thor, S.E.; Nilsson, S. (Flygtekniska foersoeksanstalten, Bromma (SE)). (Statens Energiverk, Stockholm (Sweden)). 1987. 30p. (In Swedish). (FFA-TN—1987-09). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755094/JAW.

The blade problems till now have mainly been of cosmetic nature. No damage to the primary load-bearing girder has been observed. It should be observed, however, that the next generation blades is modified for better operating properties. Experience from inspections and maintenance have pointed out the necessity of manufacturing free from maintenance blades. Repair of primary structures is practically impossible after installing the blades. The report presents a list of Maglarp experience, which could be used as a basis for further work. (O.S.).

515 **(STEV-VIND—88-4) Sea support structure for wind power plants. Influence of wave forces on design of supports.** Sigfridsson, K. (3K Engineering AB, Stockholm (SE)). (Statens Energiverk, Stockholm (Sweden)). Mar 1987. 36p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755095/JAW.

Studies in England and Sweden, among other countries, have shown that wave forces on offshore wind power stations are very important for the structural design. Already at relatively low water depths these forces determine the main dimensions of the bearing structure. Traditionally, wave forces on offshore structures are calculated in two different ways, depending on the dimensions in the splash zone. Normally Morison's Equation is used on structures with small width, while Diffraction Theory is applied to 'big volume structures'. The wave forces on the towers in the Swedish Study, respectively the English Study are compared. A new independent calculation of the wave forces on both towers was performed by Norwegian Contractors (NC) in Oslo, Norway. The results of this calculation show a relatively good agreement with the two studies (with one exception in the English study). Forces from breaking waves on the towers have also been calculated in the two studies. These forces seem to be underestimated in the English study. A rough estimate of possible cost reductions regarding construction, transportation and installation of the Swedish tower results in a 22% reduction for a single tower and a 30% reduction for 100 towers. The comparison is related to the figures presented in the Swedish study.

516 **(STEV-VIND—88-7) FFA - Basic knowledge. Proposal for activities during stage 10, July 1987 - June 1988.** Gustafsson, A. (Flygtekniska Foersoeksanstalten, Bromma (SE)). (Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma). 26 Jun 1987. 44p. (In Swedish). (FFAP—179). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755096/JAW.

The report presents background and objective of the project together with progress and results by the ending of stage 9. Proposal for activities until June 1988 and the program's connection to other wind energy projects in progress or planned.

517 **(STEV-VIND—88-10) Progress in wind energy research at Chalmers University of Technology.** Hylander, J. (Chalmers Univ. of Tech., Goeteborg (SE). Dept.of Electrical Machines and Power Electronics). (Statens Energiverk, Stockholm (Sweden)). 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755099/JAW.

The objectives of the present research program are: To investigate electrical power systems and components for large wind energy convertors, especially at variable speed operation. To investigate, together with other Swedish research institutes, variable speed operation and yaw control by means of experiments at the 40 kW test plant of the department. To continue the development of wind-diesel systems. To test small wind-energy convertors. The research activities are traditionally divided into three categories: Electrical systems. Test station operation. Wind-diesel systems. In this short presentation all three categories will be discussed separately, although some research, such as variable speed generator systems, has applications in all three groups.

518 **(STEV-VIND—88-13) Variable speed AC-drive system with pitch or yaw control.** Carlson, O.; Tsiolis, S.; Johansson, G. (Chalmers Univ. of Tech., Goeteborg (SE). School of electrical and computer engineering). (Statens Energiverk, Stockholm (Sweden)). Oct 1987. 11p. (CONF-871062—14). NTIS (US Sales Only), PC A03. Order Number DE88755100/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

With variable speed ac-drive system applied to WECS it will be possible to control the torque in the drive train and optimize the energy production. This paper describes a computer-controlled system consisting of a synchronous generator and a frequency convertor. The system is applied to a 40 kW windmill with a hydraulic system for blade pitch and yaw control. The paper compares the different control strategies of pitch and yaw control for variable speed operation. Constant speed operation is also tested. The results of laboratory measurements and theoretical calculations show that good control of the electrical torque in the generator is achieved and that harmonics are present in the generator and line currents. The field operation for the variable speed system was performed at optimal tip-speed ratio below rated wind speed and at a constant torque in the drive train above rated wind speed. A better speed control is achieved with pitch control than with yaw control. (authors).

519 **(STEV-VIND—88-16) Optimization studies of direct driven generators for wind power plants with variable speed.** Hylander, J. (Chalmers Tekniska Hoegskola, Goeteborg (SE). Inst. f. elmaskinteknik och kraftelektronik). (Statens Energiverk, Stockholm (Sweden)). Oct 1987. 35p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755101/JAW.

In an earlier paper, calculations on lowspeed gear-less generator designs have shown that the used amount of active material is reduced if the frequency of the electrical system is slightly increased. In this paper these calculations have been extended to also take into account the cost of the energy losses. The investigation is limited to a 1.5 MW synchronous generator. The calculations have shown that a suitable frequency for a low speed, gear-less synchronous generator lies between 65 ... 100 Hz. The weightreduction at 100 Hz is about 30% compared to a 50 Hz design. The losses of the frequency convertor and the harmonic effects have not been considered, so these figures must be compared with caution. To increase the efficiency of the generator at part-loads, where the generator operates most of the time, two ways can be chosen: reduction of no-load losses and reduction of the rated power of the generator. In this paper reduction of the rated power of the generator has been investigated. A typical efficiency curve of the 1.5 MW synchronous generator has been used to determine the energy production at a location of the windmill in Maglarp. If the efficiency curve is changed in relation to the rated power, the energy production can be calculated with changing rated power. The maximum increase in produced energy is 1.3% with a rated output power of windmill of 1.3 times the rated power of the generator. The wind distribution and the efficiency of other components influence these figures.

520 **(STEV-VIND—88-19) Wind measurements in tall masts. Evaluation of 7 years' measurements.** Krieg, R.; Kvick, T.; Andersson, H. (Swedish Meteorological and Hydrological Inst., Norrkoeping. Meteorology and Climatology). (Statens Energiverk, Stockholm (Sweden)). Mar 1988. 60p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755103/JAW.

This report contains a summary of measured data at 25 stations. It mainly concentrates on calculated energy values but as a complement there are also presented wind frequency distributions. As a measure of available wind energy we have used the theoretical potential energy in the wind, which has been calculated for all stations from frequency distributions of wind speed. Such a frequency distribution is statistically well described by the Weibull-distribution, which are defined by two of following factors: median wind, shape factor and scale factor. Values of these factors are presented for all stations. With these values energy production for 3 MW wind turbine with hub height 100 meters has been calculated. (authors).

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 1, 304, 537

521 **(AD-A—195700/0/XAB) Market surveillance - replacement diesel engine for military standard 60-kW diesel-engine-driven generator sets MEP-006A, MEP-105A, and MEP-115A. Report for 3 June-17 July 1987.** (VSE Corp., Alexandria, VA (USA). Environmental Power Plan Support Group). 11 Aug 1987. 72p. (VSE/EPPSG—0076-87/25RD). NTIS, PC A04/MF A01.

522 **(CONF-8810172—1) U.S. landfill gas research.** Bogner, J.; Vogt, M.; Piorkowski, R.; Rose, C.; Hsu, M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 26p. NTIS, PC A03/MF A01. Order Number DE89000527/JAW.

From 2. international conference on landfill gas and anaerobic digestion of solid waste; Chester, UK (4 Oct 1988).

This paper surveys US landfill gas R&D programs and presents some technical details of work being conducted at Argonne National Laboratory (Argonne, Illinois) through the support of the US Department of Energy. The two projects at Argonne include (1) a study of bidirectional gas movement through landfill cover materials and (2) development of standardized techniques to assay gas production from landfilled refuse (including qualitative microbiology of refuse assays).

523 **(EPRI-CS—6024) Condenser condition assessment and retrofit analysis: Ravenswood Unit 10: Final report.** Bell, R.J.; Bennett, B.A.; Rose, D.M.; Silverman, A. (Electric Power Research Inst., Palo Alto, CA (USA); Heat Exchanger Systems, Inc., Boston, MA (USA)). Oct 1988. 239p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001880/JAW.

This document covers condenser specific analyses which were performed for Con Edison's Ravenswood Station Unit 10. Base availability information was obtained from a review of unit/station records interviews with plant personnel, and logs to establish frequency and cause(s) for condensing system outages/load reductions. Problem identification and solutions considered condenser thermal performance, fouling, deaeration, leakage, corrosion and instrumentation for Ravenswood Unit 10. Unit costs for off-design operation (performance and forced outage) were developed. Retrofit cost-benefit analyses were included for several alternatives. An implementation plan as well as conclusions and recommendations were also provided. 19 refs., 18 figs., 10 tabs.

524 **(IBP-BS—137/86) Model studies on sound propagation in a cooling tower.** Schupp, G.; Thoma, W. (Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.); Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). 1986. 78p. (In German). Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.).

Up-to-date hybrid cooling towers are used in power plants. These feature low building height and reduced plume formation. The reduction of the stack effect requires the application of fans which cause noise emissions. The study on hand concerns model studies performed for sound propagation and sound sources. The authors describe the model, model sound sources, evaluation of measurements, and measurement results. They determine the relative noise-level percentages of individual noise sources of the cooling tower at emission input sites, examine the effectiveness of provided sound absorbers and mufflers, and demonstrate directive efficiency. The model measurements performed were an integral part of an engineering expertise for a low cooling tower of the Neckarwestheim II power plant.

525 **(IBP-BS—146/86) Model measurements on a low-height large-diameter cooling tower to determine the effectiveness of noise-emission control measures.** Jacobs, A.; Schupp, G.; Thoma, W. (Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.)). 1986. 31p. (In German). Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.).

The reported results were obtained by measurements performed on a low-height forced-cooling-type hybrid cooling-tower modul featuring a large-diameter truncated-cone-shaped diffusor. The authors describe the model and sound sources in the cooling tower, demonstrate the implementation and results of measurements pertaining to selected parameters, and report the effect of noise control measures which are discussed also for their effect on the A-noise-level-rated emission-input level. (HAG) With 17 figs.

526 **(NP—9770082) Simulation of soiling phenomena and their effects on heat transfer.** Eberhard, D. (Technische Univ. Hamburg-Harburg (Germany, F.R.). Promotionsausschuss). 17 Dec 1987. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89770082/JAW.

Slagging of tubes interferes with the heat transfer to the working fluid (water or steam) and obstructs the flue gas discharge pathway, thus inducing higher flow rates and pressure losses. Flue gas temperatures, gas flow rates, and solid particle concentrations were investigated with regard to their slagging effect in a sealed hot-air duct with tube bundles arranged in line or in a staggered configuration. The experimental heat exchangers each comprised 6 pipe lengths, in which slagging profiles and slag masses were measured. The thermal capacities of the tube cluster and its component tubes were measured. It was found that each configuration had a typical slagging profile. In the staggered configuration, slagging was highest in the second pipe length, with pipes arranged in line, the first section was the one with the highest slagging rate. Measurements of heat transfer throughout the heat exchanger showed that an arrangement in line is better suited for high ash concentrations in the flue gas flow. This was concluced from the fact that the rate at which the thermal power decreases with increasing slag volume is slower than in the staggered configuration if comparable boundary conditions are chosen.

527 **(NP—9770087) Influence of the foundation on vibrations of turbomachines.** Schilling, W. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Maschinenbau). 19 Jun 1986. 175p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE89770087/JAW.

The author starts by discussing the turbomachine as a vibrating system and by developing and comparing different foundation models. Two models are developed by the Finite Element Method, and their applicability to more complex models is investigated. (HAG).

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 27, 28, 29, 30, 31, 32, 34, 1669, 1710, 1969

528 **(DOE/PC/60259—T74-Vol.1) Testing conducted on the Ebara E-beam flue gas treatment system process demonstration unit at Indianapolis, Indiana: Final report.** Kawamura, Keita. (Ebara International Corp., Greensburg, PA (USA)). Jun 1988. Contract AC22-83PC60259. 253p. NTIS, PC A12/MF A01. Order Number DE88012673/JAW.

The purpose of this project was to demonstrate that the Ebara Electron-Beam technology was capable of removing SO_2 and NO/sub x/ from a flue gas slipstream of an existing utility power plant, while simultaneously producing a fertilizer byproduct of commercial value. The major achievement of the project was the demonstration that the process could achieve SO_2 and NO/sub x/ removal efficiencies exceeding 90%, over a wide variety of operating conditions, while converting the pollutants into a fertilizer byproduct consisting mainly of ammonium sulfate and ammonium nitrate sulfate and some free nitrogen. A major finding of this project was that SO_2 removal is mainly dependent on process temperature and ammonia stoichiometry, rather than electron-beam dose, once a certain level of radiation dose has been established. NO/sub x/ removal, however, depends mainly on electron-beam dose. Additionally, higher inlet SO_2 concentrations did not require higher electron beam dosages in order to maintain a constant level of SO_2 removal, indicating the value of this process to high sulfur coal operations and retrofit applications. Based on this study, it is Ebara's belief that this process has significant technical and economic advantages over current conventional processes. Ebara has under consideration, the construction of a commercial-scale, 100 megawatt demonstration facility. This project will incorporate improvements determined in previous test programs as the basis of design for utility and industrial applications. 15 refs.

529 (INIS-mf—11815, pp 322-335) **Flue gas purification in fossil-fuel power plants.** Mueh, H. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

This paper describes flue gas purification measures with reference to the example of unit 7 of Heilbronn's 'EVS' nuclear power plant, which is currently under construction. Several consecutive purification stages achieve a far-reaching abatement of the nitrogen oxide, dust, and sulfur dioxide content of flue gas. The process used to abate nitrogen oxide was developed in Japan. Dust filtration is achieved using electrofilters. To desulfurize flue gas, a so-called wet scrubbing process is employed. (orig./HSCH).

530 **(PB—88-238100/XAB) Developments in LIMB (Limestone Injection Multistage Burner) technology.** Drehmel, D.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Aug 1988. 17p. (EPA—600/D-88/164). NTIS, PC A03/MF A01.

This paper describes the most-recent results from the Limestone Injection Multistage Burner (LIMB) program, results from the wall-fired demonstration. Tests were conducted to determine the efficacy of commercial calcium hydroxide--$Ca(OH)_2$--supplied by Marblehead Lime Co. and of calcium-lignosulfonate-modified $Ca(OH)_2$. Performance of the modified sorbent was slightly better than that of the commercial sorbent. Both sorbents easily provided 50% capture of SO_2 at a calcium to sulfur molar ratio of 2.0 or less, which is the goal of the LIMB program. The paper also lists the major conclusions from the LIMB program to date.

531 **(PB—88-238183/XAB) Demonstration and pilot-scale testing of furnace sorbent injection for SO_2 control on tangentially coal-fired boilers.** Gogineni, M.R.; Clark, J.P.; Marion, J.L.; Koucky, R.W.; Anderson, D.K. (Combustion Engineering, Inc., Windsor, CT (USA)). Aug 1988. 10p. NTIS, PC A02/MF A01.

The paper discusses a program to demonstrate furnace sorbent injection on a tengentially fired, coal-burning utility boiler. The overall objective of the program is to demonstrate significant reductions in SO_2 and NOx, while minimizing any negative impacts on boiler performance. The program, which draws heavily on the procedures established under an earlier laboratory program, also includes unit-specific aerodynamic flow modeling and pilot-scale combustion testing to identify and verify optimum sorbent injection and NOx reduction approaches. The program will culminate with an 8-month demonstration test at Virginia Power's 180-MW(e) Yorktown Unit No. 2. Flue-gas humidification and low-temperature simulated sorbent recycle for enhanced SO_2 removal will also be demonstrated during the 8-month test.

532 **(PB—88-245733/XAB) Investigation for super-sorbent commercial processing. Final report, October 1984-December 1987.** Gooch, J.P.; Beittel, R.; Dismukes, E.B. (Southern Research Inst., Birmingham, AL (USA)). Aug 1988. 235p. (SORI-EAS—88-358). NTIS, PC A11/MF A01.

This report discusses making improved (super-sorbent) calcium-based sorbents commercially for EPA's LIMB (Limestone Injection in Multistage Burners) process for SO_2 removal from coal-fired utility boilers. Two processes for making super-sorbents were investigated: (1) precalcination of limestone to produce a stable, isolable CaO sorbent with the ability to react rapidly and extensively with SO_2; and (2) manufacturing $Ca(OH)_2$, in more reactive forms than are now available commercially. Precalcination seems to have negligible commercial prospects, both technically and economically. Modified hydrates, on the other hand, received major attention experimentally and is the primary focus of the report. Three ways to produce more reactive hydrates were investigated, and two classes of permanent additives were investigated. (1) surfactants and dispersants; and (2) common sugar (sucrose).

2003 Power Transmission And Distribution

533 **(CONF-881139—1) Automation of the Athens (Tennessee) electric power distribution system.** Rizy, D.T.; Stovall, J.P.; Usry, G.H. (Oak Ridge National Lab., TN (USA); Athens Utilities Board, TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012209/JAW.

From UPDEA-CIRED symposium on electricity distribution in the developing countries; No City Given, Ivory Coast (28 Nov 1988).

A large scale distribution automation research and development project has been conducted at the Athens Utilities Board (AUB) in Athens, Tennessee. The project goal was to experiment with the integrated monitoring and control of an entire distribution system from a central distribution control center. The project was sponsored by the U.S. Department of Energy, Office of Energy Storage and Distribution, Electric Energy Systems Program and managed by the Oak Ridge National Laboratory. The experience with the distribution substation monitoring and control, feeder monitoring, voltage and reactive power (vary) control, system (or circuit) reconfiguration for emergency and maintenance situations, and load control are described. A distribution automation applications software package for assessing system configuration, and volt/var control on automated radial distribution feeders was developed and is also described. 8 refs.

534 **(EPRI-EL—5507-Vol.1) Reliability-based foundation design for transmission line structures: Volume 1, Geotechnical site characterization strategy: Final report.** Spry, M.J.; Kulhawy, F.H.; Grigoriu, M.D. (Electric Power Research Inst., Palo Alto, CA (USA); Cornell Univ., Ithaca, NY (USA). Geotechnial Engineering Group). Oct 1988. 131p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001883/JAW.

Methods for optimizing geotechnical site characterization programs are examined in this study, taking into consideration that the uncertainty in the estimated geotechnical properties and exploration cost must be limited to acceptable levels. Emphasis is given to the design of site characterization programs for transmission line structure foundations. Probabilistic representations are used to model the spatial variability of soil and rock properties, and methods are presented for the estimation of geologic properties from available information prior to sampling. this information is referred to as prior information. Bayesian methods are used to combine prior information with exploration data to improve the probabilistic models of geotechnical properties. The Bayesian methods also are used to evaluate the uncertainty in model parameters for different levels of exploration effort and to estimate the optimal sample size. A strategy for the design of a site characterization program is presented using these methods, and an example of its application is given. Appendices provide a glossary of statistical terms and further information on the probabilistic analysis of geotechnical properties. 95 refs., 36 figs., 5 tabs.

535 **(EPRI-EL—5507-Vol.2) Reliability-based foundation design for transmission line structures: Volume 2, Critical evaluation of in situ test methods: Final report.** Orchant, C.J.; Kulhawy, F.H.; Trautmann, C.H. (Electric Power Research Inst., Palo Alto, CA (USA); Cornell Univ., Ithaca, NY (USA). Geotechnial Engineering Group). Oct 1988. 208p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001882/JAW.

This study critically evaluates the use of in-situ tests for site characterization, with emphasis on exploration for transmission line structure foundation design. Site characterization for transmission lines differs substantially from that of many other structures. Transmission routes traverse large distances, and the large number of structures, the variations in geotechnical conditions, and the relatively small exploration allocations necessitate optimizing the costs and benefits associated with in-situ methods of soil testing. 46 figs., 52 tabs.

536 **(EPRI-EL—5507-Vol.3) Reliability-based foundation design for transmission line structures: Volume 3, Uncertainties in soil property measurement: Final report.** Filippas, O.B.; Kulhawy, F.H.; Grigoriu, M.D. (Electric Power Research Inst., Palo Alto, CA (USA); Cornell Univ., Ithaca, NY (USA). Geotechnial Engineering Group). Oct 1988. 88p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001881/JAW.

This study presents a probability-based procedure for evaluating the uncertainties in in-situ measurements for transmission line foundation design. The steps in the procedure involve in-situ soil testing, estimating mean values of the in-situ parameters, and evaluating the uncertainties in these estimates. The uncertainties include inherent soil variability and measurement error. The resulting in-situ parameters then are combined with available prior information by using a Bayesian approach. With Bayesian updating, the final estimate of the in-situ parameters incorporates information obtained from all available sources. Models then are used to transform the in-situ parameters into the needed design soil properties. The analyses use data in the vertical direction, so they are useful primarily at a single structure site, where from one test boring or probe it is possible to evaluate the vertical variations in in-situ measurements. A general strategy for evaluating the uncertainties in undrained deep foundation design also is outlined, and the effects of the different uncertainties on the predictions are illustrated. The results show that the uncertainties are of major importance at shallow depths but, as the foundation depth increases, the uncertainties become less important. Measurement uncertainty is particularly important, and the results show that these influences should be minimized where possible. 47 refs., 29 figs., 8 tabs.

537 **(EPRI-EL—6039) Joints and terminations for pipe-type cable insulated with paper-polypropylene-paper tapes: Final report.** Engelhardt, J.S.; Ernst, A.; Gear, R.B. (Electric Power Research Inst., Palo Alto, CA (USA); Underground Systems, Armonk, NY (USA)). Oct 1988. 150p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89002063/JAW.

This work developed optimized joint and terminal options for 138--550 kV paper-polypropylene-paper (PPP) cables using conventional materials. In the process, the state of the art of conventional jointing and terminating techniques worldwide was examined and a design process formulated and presented. Test data available on hand-taped joints suggested a maximum radial design stress level of 1750 V/mil at impulse for hand-taped PPP splices. Additional testing is recommended to confirm the maximum axial stress level, but available data indicate that levels much greater than present US practice are acceptable. 86 refs., 78 figs., 16 tabs.

538 **(NEI-SE—24) More efficient transmission and distribution of electric power.** (Statens Energiverk, Stockholm (Sweden)). 23 Feb 1988. 56p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755058/JAW.

Energy losses in the Swedish transmission and distribution system for electric power are discussed in this report. The losses today (8.2 per cent) are described, the possibility to reduce the losses are investigated, and prognoses of future losses are made. (G.B.).

539 **Microwave propagation through an apertured coaxial waveguide.** Kwan, T.J.T.; Peter, W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4743-4751(1 Nov 1988).

We have studied microwave coupling phenomena in linear and nonlinear regimes. Analytic calculations and two-dimensional plasma simulations were carried out for microwave transmission in an apertured coaxial waveguide. In the linear regime, the transmission characteristics for a finite-length aperture that includes the fringing fields were obtained. In the nonlinear regime, where field emission of electrons occurs, we found that the microwave transmission was characterized by the parameter Ω^2/ω^2, where Ω is the electron cyclotron frequency in the electromagnetic field and ω is the microwave frequency. When $\Omega^2/\omega^2 << 1$ and $\Omega^2/\omega^2 >> 1$, significant microwave power can be transmitted through the aperture. For Ω^2/ω^2approx. >1, aperture closure due to field-emitted electrons becomes important, and severe degradation of microwave transmission was observed in our simulation.

540 **Probabilistic steady-state and dynamic security assessment.** Wu, F.F.; Tsai, Y.K.; Yu, Y.X. (Dept. of Electrical Engineering and Computer Sciences, Univ. of California, Berkeley, CA (US)). *IEEE Transactions on Power Systems;* **3**: No. 1, 1-9(Feb 1988).

A comprehensive framework for probabilistic steady-state and dynamic security assessment is presented. The time to insecurity is used as the measure of system security. The probability distribution of the time to insecurity is obtained form the solution of a linear vector differential equation whose coefficients are expressed in terms of steady-state and dynamic security system. An illustrative example of a simple system is given.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 649, 882, 2656, 2732

541 **(IAEA-TECDOC—463) Small reactors for low-temperature nuclear heat applications. Report of an advisory group meeting held in Winnipeg, Canada, 8-12 June 1987.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1988. 58p. (CONF-8706349—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704336/JAW.

From Advisory group meeting on small reactors for low-temperature nuclear heat applications; Winnipeg, Canada (8 Jun 1987).

In accordance with the Member States' calls for information exchange in the field of nuclear heat application (NHA) two IAEA meetings were organized already in 1976 and 1977. After this "promising period", the development of relevant programmes in IAEA Member States was slowed down and therefore only after several years interruption a new Technical Committee Meeting with a Workshop was organized in late 1983, to review the status of NHA, after a few new specific plans appeared in some IAEA Member States in the early 1980's for the use of heat from existing or constructed NPPs and for developing nuclear heating plants (NHP). In June 1987 an Advisory Group Meeting was convened in Winnipeg, Canada, to discuss and formulate a state-of-the-art review on "Small Reactors for Low Temperature Nuclear Heat Application". Information on this subject gained up to 1987 in the Member States whose experts attended this meeting is embodied in the present Technical Report. Figs and tabs.

542 **(NUREG—0020-Vol.12-No.9) Licensed operating reactors: Status summary report, data as of August 31, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration and Resources Management). Oct 1988. 480p. NTIS, PC A21/MF A01 - GPO. Order Number TI89001415/JAW.

The US Nuclear Regulatory Commission's monthly LICENSED OPERATING REACTORS Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Information Resources Management, from the Headquarters Staff of NRC's Office of Inspection and Enforcement, from NRC's Regional Offices, and from utilities. Since all of the data concerning operation of the units is provided by the utility operators less than two weeks after the end of the month, necessary corrections to published information are shown on the ERRATA page. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the Utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 559, 566, 567, 568, 569, 570, 572, 574, 576, 579, 605, 643, 644, 647, 655, 657, 658, 661, 663, 1228, 1229, 1230, 1231, 1232

543 **(CONF-881115—1) Thermally induced flow oscillation in vertical two-phase natural circulation loop.** Lee, Sang Yong; Ishii, Mamoru. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010066/JAW.

From 3. international topical meeting on nuclear power plant thermal hydraulics and operations; Seoul, Korea (14 Nov 1988).

In order to study the two-phase natural circulation during a small break loss of coolant accident in LWR, simulation experiments have been performed using Freon-113 boiling and condensation loop. In quasi-steady state, the flow became relatively stabilized and certain regular patterns of flow oscillations were detected with ranges of periods in 8-{approximately}35 seconds and 2.5-{approximately}4 minutes. In order to find out the nature of these oscillations, one-dimensional field equations for the single-phase (liquid) and two-phase region were set up, and these field equations were integrated along the loop. The homogeneous flow model was used for the two-phase region. Then the characteristic equation was derived using perturbation method. Thermal non-equilibrium and compressibility of each phase were not considered in the present analysis. The characteristic equation derived can be used to obtain the stability criteria. A simplified approach showed that the short-period oscillation were the manometer oscillation. The longer period oscillations were the density wave oscillation which had the period of oscillations close to the residence time of a fluid around the loop.

544 **(EPRI-NP—6045) Evaluation of flaws in ferritic piping: Final report.** (Electric Power Research Inst., Palo Alto, CA (USA); NOVETECH Corp., Rockville, MD (USA)). Oct 1988. 104p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001763/JAW.

This report summarizes the methods and bases used by the Section XI Task Group on Piping Flaw Evaluation to develop evaluation procedures for flaws in ferritic piping. The results from this work provide technology to evaluate flaws in accordance with Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Paragraph IWB-3650, "Acceptance Criteria for Flaws in Ferritic Piping." This report also provides guidelines for computing residual weld stresses. The flaw evaluation procedures developed in this work were verified using the results from previously performed pipe experiments.

545 **(EPRI-NP—6066) Utility response to NRC bulletin 87-01, {ital Thinning of Pipe Walls in Nuclear Power Plants}: Final report.** Mattu, R.K.; Anderson, W.F.; Connor, L. (Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., McLean, VA (USA)). Oct 1988. 437p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89002433/JAW.

The Surry Power Station feedwater pipe rupture incident on December 9, 1986, focused attention on the fact that significant erosion/corrosion could occur in piping carrying single phase water flow, in addition to erosion/corrosion pipe failure in two phase systems. Through NRC bulletin 87-01, the Staff requested all nuclear plant licensees to submit information concerning their programs for monitoring the thickness of pipe walls in high-energy single phase and two phase carbon steel piping systems. Responses to the bulletin are reviewed, and two data bases are developed based on all the relevant information supplied in their responses. The first data base deals with "Inspection Programs" and summarizes responses to NRC bulletin Questions 1, 2, 3, and 5. The second data base deals with "Inspection Results" and this summarizes responses to Question 4 of the bulletin. The report presents summaries of "Inspection Programs" and "Inspection Results." 59 refs., 6 figs., 23 tabs.

546 (IWGFPT—28, pp 137-144) **Trapped stack related PCI fuel failures.** Hoppe, N.E. (Advanced Nuclear Fuels Corp., Richland, WA (USA)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

A total of eight ANF fuel rods failed in Barsebeck Unit 1 over the years 1980 to 1982. An extensive program, including hot cell examination, was conducted to determine the cause of these failures and to avoid a recurrence of the problem. The results of the investigation showed that: 1. The fuel pellet characteristics were not a factor. 2. The fuel rod design was characterized by a large pellet cladding gap (10 mil), and a fill gas pressurization of one atmosphere absolute. These features played a major role in the failures through a thermal instability process. 3. The method of operation of Barsebeck Unit 1, characterized by slow control rod withdrawals at full power, can lead to a "trapped stack" condition. The slow uncovering of the lower part of the fuel rod provided adequate time for the thermal instability condition and associated fuel swelling effects to propagate down the rod, while stress relaxation of the cladding was prevented by the biaxial stress state created under the trapped stack condition. In addition, volatile fission products were released from the fuel at the tip of the control rod, and were deposited on the inner cladding surface. This occurred on the nearby cold region just below the control rod tip which caused the formation of "coins" which enhanced the PCI. 4. Recommendations were issued which avoided a recurrence of failures with this fuel design and this mode of operation. 5. The problem is not likely to occur with current fuel designs which have higher pressurization and smaller gaps. (author). 5 refs, 6 figs, 1 tab.

547 **(NUREG/CR—4813-Rev.1) Assessment of leak detection systems for LWRs.** Kupperman, D.S. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Argonne National Lab., IL (USA)). Oct 1988. Contract W-31109-ENG-38. 50p. (ANL—86-52-Rev.1). NTIS, PC A03/MF A01 - GPO. Order Number TI89001767/JAW.

This topical report summarizes work performed by the Argonne National Laboratory as subcontractor on on-line leak monitoring of LWRs during the 12 months from October 1987 to September 1988. 13 refs.

548 **(NUREG/CR—5134) Application of acoustic leak detection technology for the detection and location of leaks in light water reactors.** Kupperman, D.S.; Prine, D.; Mathieson, T. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Oct 1988. Contract W-31109-ENG-38. 144p. (ANL—88-21). NTIS, PC A07/MF A01 - GPO. Order Number TI89002379/JAW.

This report presents the results of a study to evaluate the adequacy of leak detection systems in light water reactors. The sources of numerous reported leaks and methods of detection have been documented. Research to advance the state of the art of acoustic leak detection is presented, and procedures for implementation are discussed. 14 refs., 70 figs., 10 tabs.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 130, 332, 543, 544, 545, 547, 548, 605, 621, 632, 637, 643, 644, 647, 651, 654, 655, 656, 657, 658, 659, 663, 1228, 1229, 1230, 1231, 1232, 1380

549 **(BNL-NUREG—41512) Evaluation of natural circulation cooldown tests performed at Diablo Canyon, San Onofre, and Palo Verde nuclear power plants.** Jo, J.H.; Perkins, K.R.; Cavlina, N. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-881115—4). NTIS, PC A02/MF A01. Order Number DE88015857/JAW.

From 3. international topical meeting on nuclear power plant thermal hydraulics and operations; Seoul, Korea (14 Nov 1988).

The natural circulation cooldown tests performed at Diablo Canyon, San Onofre, and Palo Verde nuclear power plants were evaluated for the compliance with the US Nuclear Regulatory Commission design requirements. BNL concluded that these tests combined with the supporting analyses demonstrated the natural circulation, boron mixing, and cooldown capability of these plants.

550 **(INIS-mf—11315) Diagnostics - Crack Detection '87. Collection of papers.** (Incheba, Bratislava (Czechoslovakia)). 1987. 189p. (In Czech, Slovak). (CONF-8706350—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704352/JAW.

From Symposium with international participation on diagnostics - crack detection '87; Bratislava, Czechoslovakia (23 Jun 1987).

The Proceedings of the International Symposium Diagnostics -Crack Detection '87 which was held from June 23 to 26 1987 in Sala (CSSR) contains 5 papers falling under the INIS Subject Scope. The said papers mainly deal with the problems of in-service diagnostics of pumps and steam turbines of nuclear power plants with WWER reactors, as well as crack detection of materials and welded joints of equipment and the control of the water regimen of the primary circuit of such power plants. (Z.M.).

551 (INIS-mf—11315, pp 45-48) **In-service diagnostics of selected nuclear power plant pumps.** Jaros, I. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)). 1987. (In Slovak). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88704352/JAW. (CONF-8706350—).

From Symposium with international participation on diagnostics - crack detection '87; Bratislava, Czechoslovakia (23 Jun 1987).

The following WWER nuclear power plants pumps were selected for the application of systems of in-service diagnostics: CNS 38/88 of Soviet manufacture for cooling intermediate circuits of reactor regulating rod drives, main circulating pumps, condensate pumps and pumps of the cooling intermediate circuit of the main circulating pumps and cooling of the refuelling pool. Taken into consideration in the selection was the importance of the pump and the aspects of nuclear safety and power production, the number and type of failure which had been detected in pumps in the past, requirements for and costs of the removal of individual failures and the in-service accessibility of the equipment. The system of in-service diagnostics uses the method of measurement and analysis of mechanical vibrations and the method of ultrasound field emission. Briefly summed up are the results of two years of application of the said system in the V-1 nuclear power plant in Jaslovske Bohunice. (Z.M.).

552 (INIS-mf—11315, pp 49-58) **In-service crack detection of materials and welded joints of WWER type nuclear power plant components.** Duba, Z. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The question is discussed of crack detection of materials and welded joints in WWER nuclear power plants. As concerns personnel a decision has been taken in observance of a government decree to establish in every nuclear power plant locality a unit of specially trained personnel of 35 for every four WWER-440 units. In-service inspection must involve special groups and organizations which supply the respective equipment to the plant. Attention it centred on equipment for such activity and on organizational and technical aspects relating to routine and general repairs and overhauls which include in-service crack detection, on the control of crack detection inspection by a superior body. (Z.M.).

553 (INIS-mf—11315, pp 59-64) **Experience with and techniques of diagnosing power plant steam turbines without dismantling.** Drapal, A.; Kopecek, K. (Vyzkumny Ustav Energetickych Zarizeni, Brno (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Within the framework of vibration diagnostics of steam turbines at the Dukovany nuclear power plant the following factors were monitored: the summation signal of vibrations (usually the path of vibration movement), the time course of the vibration and the phase angle. In non-steady states also run-in and run-out curves, the absolute vibration of bearing stands and the relative vibration of the rotor are monitored. The method has so far not allowed to diagnose failures of antifriction bearings, loose parts, some gear box defects, the development of cracks in vanes, radial cracks in the disk, etc. Briefly characterized is the portable equipment which is available at the Dukovany nuclear power plant for vibration diagnostics of steam turbines. Suggestions are made for completing the system for monitoring service life, operation economics, the diagnosis of control circuits, etc. (Z.M.).

554 (INIS-mf—11315, pp 90-98) **Experience with monitoring of corrosion and failure conditions in pressurized-water reactor loop using electrochemical methods.** Beran, J.; Kysela, J.; Jindrich, K. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi; Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

An experimental program of electrochemical measurement was implemented using the pressurized water loop of the WWR-S research reactor with the aim of verifying the suitability of the said methods for continuous surveillance of the water regimen in the primary circuits of WWER reactors. Four TIV probes were used for the electrochemical measurements. A probe with a gold redox electrode was placed in the active channel of the loop, one probe with an electrode of low-carbon non-alloyed steel and one probe with an electrode of zirconium alloy were placed in the measuring circuit outside the reactor. The fourth probe was used as a reference. Briefly presented are the results of the experiments which proved that electrochemical measurement in the reactor core is technically feasible. The probes provide a great number of useful data even when only partial time courses of potential in non-polarized state are computer processed. (Z.M.). 3 refs.

555 (INIS-mf—11315, pp 124-131) **Run-out evaluation in vibration diagnostics of rotary engines.** Bahna, J.; Oksa, G. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice (Czechoslovakia)). 1987. (In Slovak). (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Within the framework of in-service measurements of the main circulating pumps in WWER nuclear power plants the run-out test was suggested which was verified during the processing of non-standard measurements of the main circulating pumps at the Dukovany power plant. The computer program for monitoring changes in the frequency spectrum of the non-steady state signal allows to select the operating frequency range, the number of spectra estimates, the number of identified spectra, the time interval of identified spectra, etc. The method used for evaluating records of measurements of the run-out of the main circulating pumps allowed to identify certain natural resonances of the pump in the low-frequency area of 2 to 40 Hz. So far the possibility has not been studied of assessing the properties of bearings by diagnostic measurements implemented during pump run-out. (Z.M.).

556 **(INIS-mf—11793) KWO annual report 1986.** Koerner, C. (comp.). (Kernkraftwerk Obrigheim G.m.b.H. (Germany, F.R.)). 1987. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755162/JAW.

The Obrigheim nuclear power station was operated at full load during the year 1986; 7869 operating hours procuded electrical energy of 2795 GWh. This is the best annual result during Obrigheim's operating period. Since commissioning in October 1968, 131595 hours of operation have generated 44074 GWh (gross) and from test operation in March 1969 until the end of 1986, 131179 hours of operation have generated 43,962 GWh. This is an availability of power of 81.5% in this period and a time availability

of 83.9%. In 1986, the plant was shut down for 807 hours for the 17th refueling including refurbishing, inspection and repair work. Apart from refueling, the plant had a good time availability and therefore contributed 5% to the safe, economical and environmentally acceptable electricity supply of the Land Baden-Wuerttemberg.

557 (INIS-mf—11815, pp 300-307) **Current state of the project of the nuclear power plant at Wyhl.** Mueh, H. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

Electric power consumption is today increasing at a lower rate than the 7 per cent a year forecast. Growth rates over the last years ranged between 3 and 4 per cent throughout. The decision about the erection of a new nuclear power plant, which continues to be a desirable achievement to create optimum conditions to meet power demand of base-load character, will be taken in the next one or two years to come. It will at the same time be the decision about the future of the Wyhl nuclear-power-plant project. (orig./HSCH).

558 (IWGFPT—28, pp 19-25) **Release of volatile fission products in the PWR primary coolant during power transients.** Leuthrot, C.; Beslu, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Since several years, activities of short-lived fission products have been measured by EDF and CEA on French commercial PWRs running with cladding defects. More recently, investigations have been performed in order to understand the behaviour and to determine the release rate of volatile fission products in load follow conditions. These studies are mainly related to volatile fission products such as /sup 133/Xe, /sup 135/Xe, /sup 131/I, /sup 133/I, / sup 134/Cs, /sup 137/Cs. It has been shown that several parameters have an effect on the transient release rate: power increase/decrease rates; power levels; size and localization of the defect; repetition of the transients. At the moment, no comprehensive gap to primary circuit release model has been set up and data available for various experimental conditions do not allow to distinguish the separate effects of each parameter on the transient release rate. Nevertheless for a typical load follow transient, the effect of the defect size and repetition of the transient have been studied and values of the transient release rate have been obtained for gases, iodines and cesiums. The increase of gases activities during load follow is less than 20% whatever the defects sizes are. For small defects the iodine release is very low and not enhanced by power transient. For larger defects, the iodine transient release may be enhanced up to 50% compared with steady state release. Cesium release is negligible during load follow transients except for very large defects where 5% of the gap inventory has been released in the primary coolant. (author). 8 figs.

559 (IWGFPT—28, pp 25-32) **Comparative studies of axial gas mixing in fuel rods with standard and rifled cladding.** Kjaer-Pedersen, N.; Kinoshita, M.; Mogard, H. (Studsvik of America, Inc., Richland, WA (USA); CRIEPI (Japan); Studsvik Energiteknik AB, Nykoeping (Sweden)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

This paper presents a joint numerical study of axial gas mixing by CRIEPI and Studsvik. The codes EIMUS and INTERPIN are used to analyze the above described phenomena. The study focuses on the relative influence of the diffusional delay in cases of open gap and closed gap for standard cladding, and illustrates the effectiveness of the rifled design in enhancing gas mixing. The study also concludes that the pumping action resulting from heat rating changes is an important factor in achieving fission gas concentration equilibrium. 9 refs, 15 figs.

560 (IWGFPT—28, pp 32-37) **Fission gas release during power transients at high burnup.** Porrot, E.; Lemaignan, C.; Raybaud, A.; Baron, D. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Electricite de France, Lyon (France). Service Etudes et Projets Thermiques et Nucleaires; Fragema, 69 - Lyon (France)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Within the framework of a cooperative programme between EDF, Fragema and CEA, sweeping gas experiments were performed on a Fragema standard fuel rod irradiated to a BU of 35,000 MWd.T/sup -1/ in a power reactor. After hot cell transformation of the rod and welding of the sweeping lines, the rod was reirradiated in the Siloe pool reactor at Grenoble and FGR measurements were performed on line, using the fission product laboratory located next to the pile. Several types of power transients were analysed. Instantaneous FGR is characterised by strong emission during power increase and power decrease, and moderate steady state release during the power plateau. The overall balance is such that the main part of the release during a transient is due to the two peaks associated with power change. The analysis of the behaviour of the various radioisotopes suggest some mechanisms of FG accumulation and release. (author). 7 refs, 7 figs.

561 (IWGFPT—28, pp 37-43) **Investigation of parameters affecting WWER-type fuel behaviour under transient conditions.** Novikov, V.V.; Bibilashvilij, Yu.K.; Golovnin, I.S.; Shchavelin, V.M.; Bozhko, Yu.V.; Bolobolichev, A.M. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR); Moscow Engineering and Physical Inst. (USSR)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

The experience gained from the operation of water cooled reactor cores and studies into the problems related to their reliability made it possible to establish that the gravest cause limiting the fuel serviceability is a thermal-mechanical interaction between dioxide fuel and zirconium alloy clad. This problem has long been urgent due to the steady quest for increased burn-up, increased fuel cycle and NPP operation under load follow conditions. The studies established the main regularities of fuel failure due to a fuel-clad interaction involving a simultaneous effect of tensile stresses and aggressive fission products on a clad. In addition to the rate of a power rise and the amount of a power ramp tensile stresses are also affected by the extent of a frictional interaction between fuel pellets and cladding. The paper presents the results of the study into the fuel-cladding friction, as well as the data on the iodine induced embrittlement of a clad used to validate the fuel serviceability. (author). 2 refs, 9 figs.

562 (IWGFPT—28, pp 44) **Mechanical behaviour of LWR fuel rod cladding during load follow at high burnup.** Vliet, J. van; Haas, D. (Societe Belge pour l'Industrie Nucleaire, Brussels). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

563 (IWGFPT—28, pp 45-53) **Sustained fatigue of Zircaloy-4 claddings - Non-irradiated material.** Lemoine, P.; Darchis, L.; Pelchat, J.; Mardon, J.P.; Grosgeorge, M. (CEA, Lyon (France). Inst. de Recherche Technologique et de Developpement Industriel; Fragema, 69 - Lyon (France); Electricite de France, Villeurbanne (France). Service Etudes et Projets Thermiques et Nucleaires). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

The adaptation of PWR operating conditions to future plant conditions makes it necessary to anticipate the impact of load follow and frequency control on fuel performance. This is why FGA, EDF and CEA have launched an extensive qualification program covering the fatigue and fatigue-creep characterization of the cladding material (stress-relieved Zy4). A device simulating load cycling of heated cladding portions was developed as part of this program. The claddings were subjected to fatigue at 350 deg. C by the repeated action of internal pressure. The sustained fatigue curve and the endurance limit at 10/sup 6/ cycles were thus determined for the chosen frequency (f=0.5Hz). The results, corrected by the biaxiality effect, are consistent with those hitherto published for monoaxial fatigue. Another important improvement was made in the interpretation of the scatter of fatigue results: the fatigue resistance of the tested claddings can be correlated with their creep resistance. This means that even at this frequency there is interaction between fatigue and creep. (author). 2 refs, 6 figs, 5 tabs.

564 (IWGFPT—28, pp 57-63) **Combined utilization of BR3 and BR2 reactors for power ramping and cycling tests of high burnup fuel rods.** Motte, F.; Haas, D. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Societe Belge pour l'Industrie Nucleaire, Brussels). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

The BR3 pressurized water reactor and the BR2 material testing reactor are both located on the site of the Belgian Nuclear Research Centre at Mol (Belgium). Because of this favourable feature and due to the great technical flexibility of both irradiation facilities as far as irradiation performance is concerned, many experimental programmes aimed at the qualification of advanced PWR fuel are being conducted. They are either performed on a national basis or sponsored by foreign organizations including fuel vendors, utilities and research laboratories, in the frame of international collaborations or bilateral agreements. The report presents the main characteristics of BR3 and BR2: the first reactor is used for testing in a broad spectrum of irradiation conditions and histories the fuel behaviour up to high burn-up and the latter for performing power ramping and cycling experiments on some representative fuel pins at increasing burn-up levels, as made available at the end of each BR3 irradiation campaign. More emphasis will be put on the objectives and experimental features of the most recently performed ramp tests and on the cycling tests. (author). 6 refs, 4 figs, 1 tab.

565 (IWGFPT—28, pp 64-77) **Irradiation facilities of the CEA/DERPE for power ramping and power cycling experiments.** Friboulet, C.; Roche, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Power ramping and power cycling experiments are performed in the DERPE reactors in Grenoble (SEDTI) and in Saclay (SERI). Irradiations can be done with fresh or pre-irradiated fuel rods, long (2m) or short ones, instrumented or not, with normal uranium oxyde, gadolinium oxyde, or mox fuels. The devices used for these experiments operate in PWR range of pressure and temperature. They are: one fuel rod capsules; AQUILON (long rods), BOSS (short ones), GRIFFON (superposed instrumented short rods). One fuel rod loops; ISABELLE 1 (short or long rods), JET PUMP (short rods with leak clad). Multi fuel rod loops; ISABELLE 4 (4 short or long rods), IRENE (9 short or long rods, can operate with void ratio until 25%), OPERA loop, in design (36 long fuel rods). Power variations are carried out by mechanical displacement devices or gaseous neutron absorbers. The ramps can be monitored by computers from one irradiation parameter (usually the power). Instrumentation is distributed on the devices: thermocouples, pressure gauge, SPND, and on the samples: high temperature thermocouples in the fuel or the clad, fission gas pressure gauges, diameter and longitudinal section measurement, thermal noise, accelerometer. Out of the irradiation time, non destructive examinations can be done: metrology - neutronradiography - gamma scanning - eddy current. Various types of power ramping and cycling will be shown as well as non destructive testing results. (author). 11 refs, 12 figs.

566 (IWGFPT—28, pp 77-84) **Investigation of multi-ramp and load following behaviour of LWR fuel rods at the HFR Petten.** Markgraf, J.F.W.; Perry, D.J.; Ruyter, I.A.; Fischer, G.; Sontheimer, F. (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Brennelement- und Bestrahlungstechnologie; Kraftwerk Union A.G., Erlangen (Germany, F.R.)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Experimental programmes addressing the multi-ramp and load following behaviour of LWR fuel rods have been carried out at the HFR Petten as a joint undertaking of KFA Juelich, KWU Erlangen and JRC Petten. The aim of both programmes was to demonstrate that LWR fuel provides the necessary operational flexibility with regard to fuel management and modern power control strategies. The multi-ramp behaviour of fuel rods with a preirradiation burnup of 9 to 19 GWd/t(U) for the BWR rods and 25 to 32 GWd/t(U) for the PWR rods was investigated. The preirradiations in all cases were performed in commercial power reactors. Ramp tests were executed after a brief conditioning period at the HFR and again after a burnup increment of max. 10 GWd/t(U) had been reached. One fuel rod was exposed to a third ramp test after an additional burnup increment. In general, these tests yielded the following results: Fuel rods are multi-ramp resistant if the power ramp history at incremental burnups of up to 10 GWd/t(U) is comparable as to power level and if the successive power ramps exceed the previous power ramp level by less than 50 W/cm LHGR. The load following tests with PWR fuel rods having a burnup level up to 40 GWd/t(U) has further confirmed the excellent results obtained in earlier test programmes performed at HFR and KWU where fuel rods having a burnup of up to 25 GWd/t(U) were tested. The most important findings of these tests were: Compared to steady state power operation, load following mode does not lead to any additional restrictive effects for the fuel rods; Dimensional changes to the fuel rods are negligible. The contribution addresses the experimental programmes, their objectives, test procedures, typical results and conclusions. (author). 13 refs, 6 figs.

567 (IWGFPT—28, pp 84-93) **KWU's experimental basis for power ramping and cycling performance of LWR fuel.** Knaab, H.; Gaertner, M.; Sontheimer, F. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Right from the beginning of commercial operation of nuclear power plants KWU has studied the consequences of load follow operation for the fuel performance. The first power cycling experiments were started in 1970 in KWO and HFR Petten. Altogether four power cycling tests have been performed at various power and burnup levels. The fuel rod performance compares well with fuel rods under steady operating conditions at comparable power levels, demonstrating the excellent load follow capability of Zry/UO/sub

2/ fuel rods. After recognition of the PCI failure mechanism KWU initiated also an experimental power ramping programme on the basis of pre-irradiating segmented rods in power reactors and subsequent ramp testing in the HFR Petten. These tests were backed by ramping of KWU test rods in many international power ramp projects conducted by Studsvik Energiteknik. Additionally, integral power ramp tests were performed in KWO and KWB-A to verify the applicability of the results gained in the research reactors to the power reactors on a broader statistical scale. The paper provides a synopsis of the power ramp test results and an analysis in the frame of the RSST-approach: Failure thresholds (safe range) were determined for PWR rods up to 45 GWd/t(U) and BWR rods up to 35 GWd/t(U), pellet density and pellet to clad gap were important variables; The safe power step above the threshold from a conditioned power level could be derived for BWR rods up to 20 GWd/t(U); Power ramp speeds for safely passing the threshold were determined with BWR rods up to 30 GWd/t(U); The safe time was determined to be in the range of minutes, a time span well above the duration of reactivity induced transients. Multiple ramp tests were performed to study the de-conditioning during further irradiation. The above experimental data together with the operational experience from power reactors form the basis for defining operating guidelines and control system set points for KWU power plants.

568 (IWGFPT—28, pp 93-101) **Power ramping test programme on Fragema fuel rods during the years 1984 to 1986.** Lefebvre, F.; Joseph, J.; Royer, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie; Fragema, 69 - Lyon (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Fragema and CEA have carried out a large-scale R and D programme to study the effect of transients on fuel behaviour, especially with regard to PCI. The FABRICE technique has been used to study portions of fuel rods previously irradiated in commercial reactors. The tested fuel rods were of Fragema design and cut from long rods, which were previously irradiated in the CAP reactor and/or the FESSENHEIM UNIT 2 power plant. Before ramping, those coming from CAP were subjected to daily load follow and frequency control in conditions representative of power reactors. The peak burnups ranged between 20 MWd/kg U and 35 MWd/kg U. The rods were precisely characterized before ramp testing. Power ramp tests were performed in the CEA OSIRIS and SILOE reactors. No failures were detected on the rods, at linear heat rating ranging between 400 W/cm and 640 W/cm. The post-irradiation examination showed important sharp increase and important large ridges at mid-pellet sections. Fission gas measurements indicated extensive releases at high power level. Fuel creep can explain the fact that no failures were detected at high linear heat rating. The extension of this programme done in co-operation with EDF is now in progress in order to increase the database to burnups higher than 30 MWd/kg U on CAP rods and higher than 55 MWd/kg U on fuel rods previously irradiated in FESSENHEIM. (author). 9 refs, 6 figs, 2 tabs.

569 (IWGFPT—28, pp 105-109) **Survey of load follow experience in US light water reactors.** Goldstein, L.; Sheppard, K.D. (Stoller (S.M.) Corp., New York (USA)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

Load follow experience in U.S. LWRs is increasing and, while still not widespread, a number of units have accumulated significant experience. In this paper load follow experience in U.S. PWRs and BWRs is discussed, including both load follow demonstration tests and commercial load follow experience. Load follow demonstration tests have been performed at a number of units. The objectives and results of such tests are discussed, including: testing the ability of various computer codes to predict load follow behavior; testing the ability of the operating staff to perform load follow maneuvers within the vendor's power recovery guidelines; tests of remote dispatching systems; determining the margins to safety limits required for load follow flexibility. Commercial load follow operations have been performed not only because of grid load demands, but also for reasons such as the need to husband the reactor until a scheduled outage and to comply with environmental requirements on cooling water discharge temperatures. An unusual benefit of load follow occurred in one BWR which load followed during an end of cycle coastdown. In this case, an energy generation increase occurred because of a power overshoot on return to power. This overshoot was the result of xenon depletion during the period of low power operation. Load follow testing in the U.S. will be reviewed, and U.S. commercial daily load follow experience will be discussed for several PWRs and BWRs with the most extensive experience, including: number of load follow cycles; range of power changes; impact on fuel performance as indicated by primary coolant activity (PWRs) or off-gas activity (BWRs); impact on the performance of non-fuel core components; capacity factor losses due to restrictions on the rate of return to power. (author). 2 tabs.

570 (IWGFPT—28, pp 110-115) **Strategy and experience of PCI protection and load following operation in KWU LWR plants.** Jan, R. von. (Kraftwerk Union A.G., Erlangen (Germany, F.R.)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

The strategies of protecting the fuel against PCI failures during plant operation are described. The basic concept involves a sliding PCI limit for the local peak power, which accounts for conditioning effects of the previous power history. Plant specific features and the use of control rods are summarized for PWR and BWR plants. KWU PWRs are equipped with fully automatic control and limitation systems, which allow fast load following operation within the operating and PCI limits. Experience shows that the methods are 100% successful to prevent PCI failures, and that the plants can be operated without restrictions. In BWRs, administrative methods are used with either regional core surveillance by in-core detectors or local surveillance by a fast calculator. PCI related restrictions are presently removed or minimized by introducing new fuel designs (Zr barrier tubing, 9x9 fuel). An increasing number of plants operate successfully in daily or weekly load following modes or with remote control according to varying power demands. The relevant experience is summarized. (author). 10 refs, 8 figs.

571 (IWGFPT—28, pp 116-124) **Impact of load modulation on fuel behaviour.** Grosgeorge, M. (Electricite de France, Villeurbanne (France). Service Etudes et Projets Thermiques et Nucleaires). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

In this paper, the main potential effects of load modulation operation on fuel behaviour are identified: increase of internal rod pressure, cladding fatigue damage, modification in the cladding mechanical equilibrium and subsequent increase of the stress level during a given transient. The magnitude of these effects depends notably on local rod power history. Unfortunately, the ex-core instrumentation system does not allow local power evaluation in the core; consequently, on-line evaluation of the impact of load modulation is not possible. Therefore a conservative method has been developed for load modulation simulation. Fuel management, reactor control and load modulation neutronical calculations are first carried out. Based on these hypotheses, fuel thermomechanical studies yield the maximum values of criterion-limited parameters. For example, in the case of 3,7% enriched fuel operating for 3 cycles, the rod pressure does not exceed 150 bar (155 bar for external coolant pressure); cladding fatigue damage remains in the 30-40% range. For 3,7% Fragema fuel management (900 MWe units), after an initial 75-day period (first cycle excluded), an initial "credit" of 66

days is available, decreasing or being restored according to unit power level. Equivalent specifications have to be established for other fuel designs and other plant series (M3, 1300 MWe units, etc...). New fuel designs and/or new fuel managements will be also treated. Corresponding fuel studies will be improved, especially with experimental programs contribution. 2 refs, 9 figs.

572 (IWGFPT—28, pp 125-131) **Load follow impact on fuel behaviour experimental results.** Morel, M.; Melin, P.; Gautier, M.; Houdaille, B. (Fragema, 69 - Lyon (France); Electricite de France, Villeurbanne (France). Service Etudes et Projets Thermiques et Nucleaires; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

The size of the French nuclear plant installed capacity has led EDF to optimize plant unit operating conditions. In particular, an increasing number of power plants now operate on grid follow (load variation); these more severe fuel utilization conditions justify the scale of the experimental programme set up jointly by CEA, EDF and Fragema. The aims of this programme are to: determine the maximum loads the fuel can sustain without damage; gain wider knowledge of the loadings and other phenomena inflicted on the fuel when it is subjected to grid follow; demonstrate that overall fuel behaviour is unchanged by grid follow. The programme provides identification of the phenomena potentially limiting fuel performance. (author). 7 refs, 3 figs, 2 tabs.

573 (IWGFPT—28, pp 131-137) **Update on the burnup dependence of pellet cladding interaction.** Andrews, M.G.; Lavake, J.C. (Combustion Engineering, Inc., Windsor, CT (USA)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

A series of relatively standard PWR rodlets irradiated in the Obrigheim Reactor to burnups of 30 to 46 GWd/MTU were tested in the HFR Petten Reactor in the Netherlands as part of a program sponsored by the U.S. Department of Energy. The results showed three failures at 405, 430, and 470 W/cm with 8 rodlets surviving to powers in the range of 385 to 430 W/cm. These results also tended to confirm the relationship of failure potential with power change, that is, the increase in power level above the conditioning level or the highest power in the base irradiation. An additional pair of fuel rodlets from this series did not fail after being subjected to a second ramp in power after 6 GWd/MTU additional burnup. Ramp testing conducted at Studsvik's R-2 Reactor on rodlets of the same design resulted in no failures in ten tests with burnups in the range of 33 to 45 GWd/MTU. Although the combination of the Studsvik and Petten tests is encouraging to any utility operating fuel rods of this type in PWRs, they are few in number and leave open the following two questions, among others. Is there anything unique to the design of these rodlets that provides the resistance to PCI, or is it the additional burnup that was responsible for the absence of failures? If PWR fuel rods at extended burnups are less susceptible to PCI, what is the important property of the fuel rod that changes to cause the improved resistance? Although answers to these important questions may not be available, a few suggested explanations will be offered as guides to future work in this area. 3 refs, 3 figs, 5 tabs.

574 (IWGFPT—28, pp 145-151) **Load follow and frequency control operating experience of Fragema fuel in EDF reactors.** Dumont, A.; Bournay, P. (Fragema, 69 - Lyon (France); Electricite de France, 75 - Paris). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

In France, by 1990, the electrical power production produced by Nuclear Power, should reach 75%, it already was 70% in 1986: this means that most EDF nuclear reactors must operate on load follow and frequency control to allow the production of electricity to follow variation in consumption. The experience acquired in power reactors is now very extensive and is unique in the world. A few batches have undergone 3 cycles of irradiation while operating on load follow and have cumulated up to 260 power cycles. Equally, a few batches of fuel assemblies have cycles totalling 520 days operation on frequency control. Some cycles of irradiation had up to 110 load follow cycles or up to 300 days operation on frequency control. As of December 1986, nearly 2,800 load follow cycles have been realized in 85 irradiation cycles and nearly 7,800 days operating on frequency control have been accumulated in 64 irradiation cycles. In each case, the fuel behaviour during load follow operation or frequency control operation was satisfactory: no bad influence of this type of operation on the fuel behaviour was observed and in particular there was no influence on the occurrence frequency of leakages. The excellent behaviour of Fragema fuel already observed during base load operation is thus confirmed for operating modes such as load follow and frequency control (author). 3 refs, 9 figs.

575 (IWGFPT—28, pp 151-160) **Operational experience of the WWER-1000 reactor fuel elements and fuel assembly for the Novo-Voronezh fifth power unit with a three-year fuel life cycle.** Proselkov, V.N.; Dukhovenskij, A.S.; Fatieva, N.L.; Zakharko, Yu.A.; Zaletnykh, B.A.; Miroshnichenko, M.I.; Kiryukhin, G.S.; Shmelev, V.D.; Demin, E.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

The operational experience of the WWER-1000 reactor fuel for the Novo-Voronezh NPP fifth power unit for the whole period of operation including passing to the three-year fuel life-cycle with the use of 4.4% enrichment FA, is considered in the paper. The FA and fuel elements were shown to keep their operability in operating for three fuel loads and in attaining the burnup depth up to 37.4 MW.day/kgU. (author). 2 refs, 3 figs, 2 tabs.

576 (IWGFPT—28, pp 161-163) **Japanese power ramping and load following programme since the Petten meeting.** Mishima, Y. (Tokyo Univ. (Japan)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

577 **(KFK—4413) Comparison of computer code calculations with FEBA test data.** Zhu, Y.M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). Jun 1988. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755421/JAW.

The FEBA forced feed reflood experiments included base line tests with unblocked geometry. The experiments consisted of separate effect tests on a full-length 5x5 rod bundle. Experimental cladding temperatures and heat transfer coefficients of FEBA test No. 216 are compared with the analytical data postcalculated utilizing the SSYST-3 computer code. The comparison indicates a satisfactory matching of the peak cladding temperatures, quench times and heat transfer coefficients for nearly all axial positions. This agreement was made possible by the use of an artificially adjusted value of the empirical code input parameter in the heat transfer for the dispersed flow regime. A limited comparison of test data and calculations using the RELAP4/MOD6 transient analysis code are also included. In this case the input data for the water entrainment fraction and the liquid weighting factor in the heat transfer for the dispersed flow regime were adjusted to match the experimental data. On the other hand, no fitting of the input parameters was made for the COBRA-TF calculations which are included in the data comparison.

578 **(ND-R—1173(S)(pt.4)) MERLIN programme: Pt. 4. The assembly of an instrumented electrically heated PWR 6 x 6 cluster for the thermal hydraulic series of tests.** Clifford, B.R.; Walker, J.C. (UKAEA Northern Research Labs., Springfields). (UKAEA Northern Research Labs., Risley (UK)). Mar 1988. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755442/JAW.

The MERLIN (Multi Rod Electrically heated Rig for LOCA INvestigation) rig at Springfields Nuclear Laboratories (SNL) is used to investigate the deformation behaviour of Zircaloy fuel rod cladding in a Pressurised Water Reactor (PWR) following a postulated large break loss-of-coolant accident (LOCA). This Report describes the components, instrumentation and assembly of a 6 x 6 cluster of electrically heated fuel rod simulators which can be subjected to temperature transients and bottom reflood in order to determine the thermal hydraulic characteristics of the rig.

579 **(NUREG/CR—5220-Vol.1) Diagnosis of condensation-induced waterhammer: Methods and background.** Izenson, M.G.; Rothe, P.H.; Wallis, G.B. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Creare, Inc., Hanover, NH (USA)). Oct 1988. 155p. (CREARE-TM—1189-Vol.1). NTIS, PC A08/MF A01 - GPO. Order Number TI89002152/JAW.

This guidebook provides reference material and diagnostic procedures concerning condensation-induced waterhammer in nuclear power plants. Condensation-induced waterhammer is the most damaging form of waterhammer and its diagnosis is complicated by the complex nature of the underlying phenomena. In Volume 1, the guidebook groups condensation-induced waterhammers into five event classes which have similar phenomena and levels of damage. Diagnostic guidelines focus on locating the event center where condensation and slug acceleration take place. Diagnosis is described in three stages: an initial assessment, detailed evaluation and final confirmation. Graphical scoping analyses are provided to evaluate whether an event from one of the event classes could have occurred at the event center. Examples are provided for each type of waterhammer. Special instructions are provided for walking down damaged piping and evaluating damage due to waterhammer. To illustrate the diagnostic methods and document past experience, six case studies have been compiled in Volume 2. These case studies, based on actual condensation-induced waterhammer events at nuclear plants, present detailed data and work through the event diagnosis using the tools introduced in the first volume. 65 figs., 8 tabs.

580 **(PB—88-237318/XAB) Health-hazard evaluation report HETA 86-456-1877, South Texas Nuclear Project, Wadsworth, Texas.** Sinks, T.H.; Hartle, R.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1988. 25p. (HETA—86-456-1877). NTIS, PC A03/MF A01.

An evaluation was made of an outbreak of dermatitis among workers at the South Texas Nuclear Project construction site, Wadsworth, Texas. The dermatitis occurred ten times more frequently among carpenters than other laborers, with the incidence in 1986 being 250% greater than it was in 1985. Some workers demonstrated pruritic, macular/papular lesions. Carpenters working on the inside of the power-project buildings had a higher incidence of skin disease than those employed on the outside of the buildings. Samples of plywood and lumber treated with fire-retardant indicated that they contained 3 and 5% phosphate, respectively. Arsenic was not detected but formaldehyde was detected at 59 parts per million. General environmental air samples were taken with no evidence found of airborne phosphate, melamine, dicyandiamide, or formaldehyde. Concentrations of total particulates ranged from 0.1 to 0.6mg/m^3. The authors conclude that the workers were probably suffering from a contact dermatitis. The authors recommend specific precautions.

581 **(EPRI-NP—4574-CCM-Pt.2-Ch.11-Vol.3) ARMP-02 documentation: Part II, Chapter 11, NODE-P2 computer code manuals: Volume 3, Programmer's manual.** Anderson, M.J. (Electric Power Research Inst., Palo Alto, CA (USA); Levy (S.), Inc., Campbell, CA (USA)). Oct 1988. 75p. Research Reports Center, Box 50490, Palo Alto, CA 94303.. Order Number TI89002059/JAW.

NODE-P2 is a core-simulator code for PWR's. It performs three-dimensional calculations of core behavior at normal steady-state conditions based upon a one-energy-group model. It can perform step-wise macroscopic depletion calculations for the core, but Iodine-135 and Xenon-135 are the only isotopes whose behavior it accounts for explicitly. It also can generate data files whose contents can be processed, directly or indirectly, into physics parameters for input to kinetics codes.

582 **(EPRI-NP—4574-CCM-Pt.2-Ch.11-Vol.1) ARMP-02 documentation: Part 2, Chapter 11, NODE-P2 computer code manuals: Volume 1, Theory and numerics.** Mosteller, R.D. (Electric Power Research Inst., Palo Alto, CA (USA); Levy (S.), Inc., Campbell, CA (USA)). Oct 1988. 139p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89002061/JAW.

NODE-P2 is a core-simulator code for pressurized water reactors. It performs three-dimensional calculations of core behavior at normal steady-state conditions based upon a one-energy-group model. It can perform step-wise macroscopic depletion calculations for the core, but Iodine-135 and Xenon-135 are the only isotopes whose behavior it accounts for explicitly. It also can generate data files whose contents can be processed, directly or indirectly, into physics parameters for input to kinetics codes. 43 refs., 18 figs., 8 tabs.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 640, 658, 891

583 **(JAERI-M—88-107) Irradiation-induced dimensional changes of fuel compacts and graphite sleeves of OGL-1 fuel assemblies.** Hayashi, Kimio; Minato, Kazuo; Kobayashi, Fumiaki; Tobita, Tsutomu; Kikuchi, Teruo; Kurobane, Shiro; Adachi, Mamoru; Fukuda, Kousaku. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jun 1988. 115p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755215/JAW.

Experimental data are summarized on irradiation-induced dimensional changes of fuel compacts and graphite sleeves of the first to ninth OGL-1 fuel assemblies. The range of fast-neutron fluence is up to 4 x 10/sup 24/ n/m/sup 2/ (E > 0.18 MeV); and that of irradiation temperature is 900 - 1400 deg C for fuel compacts and 800 - 1050 deg C for graphite sleeves. The dimensional change of the fuel compacts was shrinkage under these test conditions, and the shrinkage fraction increased almost linearly with fast-neutron fluence. The shrinkage fraction of the fuel compacts was larger by 20 % in the axial direction than in the radial direction. Influence of the irradiation temperature on the dimensional-change behavior of the fuel compacts was not observed clearly; presumably the influence was hidden by scatter of the data because of low level of the fast-neutron fluence and the resultant small dimensional changes.

584 **(NUKEM-FuE—86034) Development program for fuel elements with low enriched uranium for high temperature reactors. Final report. Reported period: January 1, 1982 - December 31, 1986.** (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1987. 72p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755293/JAW.

The results of HTR fuel development taking place at the THTR's can be summarized as follows for the main points of core manufacture coating matrix and fuel emenent manufacture: 1. The well known gel precipitation process was modified for the manufacture of UO/sub 2/ cores. 2. The TRISO coating (additional SiC layer between two very dense PyC layers) can be applied with the required quality on an economical 10 kg scale. 3. The particle fracture in the complete fuel element due to manufacture was lowered during the course of the project to below the target values of <60x10/sup -6/ U/U total. For testing fuel elements, the required irradiation samples were designed in agreement with the reactor

constructors, were prepared and the first phase of the irradiation program was successfully completed in the context of the HBK project.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

585 (IWGFPT—28, pp 17-18) **Generation maneuvering at BRUCE NGS-B: fuel fission gas release results.** Truant, P.T.; Hains, A.J.; Lau, J.H. (Ontario Hydro, Toronto (Canada)). May 1988. NTIS (US Sales Only), PC A08. Order Number DE88014011/JAW. (CONF-8705237—).

From IAEA technical committee meeting on power ramping cycling and load following behaviour of water reactor fuel; Lyon, France (18 May 1987).

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 636, 658, 665, 666, 1287, 1294

586 **(AERE-M—3682) Benchmarking workstations with the fast reactor fuel performance code TRAFIC.** Thetford, R. (UKAEA Harwell Lab. Theoretical Physics Div.). Jun 1988. 7p. H.M. Stationery Office, London, price Pound 4.00.

TRAFIC is a moderately large FORTRAN program used to model the behaviour of fuel pins in a nuclear reactor. TRAFIC has been run on a number of workstations, to evaluate their performance on problems likely to be encountered in fuel modelling. A comparison is also made with the performance of the Harwell Cray-2 and IBM 3084-Q systems. This memorandum presents the results of the evaluation exercise, and gives some indication of their applicability to other codes.

587 **(CONF-881115—2) Three-dimensional thermal-hydraulic analysis of a liquid metal reactor design with the COMMIX code.** Shin, Y.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010067/JAW.

From 3. international topical meeting on nuclear power plant thermal hydraulics and operations; Seoul, Korea (14 Nov 1988).

Steady-state and transient thermal-hydraulic analysis of a liquid metal reactor (LMR) design have been performed with the COMMIX computer code and the results are discussed. The LMR design analyzed includes an inherent safety feature which enables the decay heat removal by natural convection of ambient air, and the purpose of this analysis is to evaluate the inherent safety feature of the LMR design. COMMIX is a three-dimensional thermal-hydraulic analysis computer code developed at Argonne National Laboratory. A single-phase version of COMMIX has been used. Radiation plays an important role in the overall heat transfer, and the COMMIX version used includes the radiation capability. The theoretical formulation of COMMIX, including the treatment of thermal structures and radiation, is also discussed. 6 refs., 8 figs.

588 **(CONF-881120—1) Analytical studies on the impact of using repeated-rib roughness in LMR [Liquid Metal Reactor] decay heat removal systems.** Obot, N.T.; Tessier, J.H.; Pedersen, D.R. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010051/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

A numerical study was carried out to determine the effects of roughness on the thermal performance of Liquid Metal Reactor (LMR) decay heat removal systems for a range of possible design configurations and operating conditions. The ranges covered for relative rib height (e/D/sub h/), relative pitch (p/e) and flow attack angle were 0.026–0.103, 5–20 and 0–90 degrees, successively. The heat flux was varied between 1.1 and 21.5 kW/m^2 (0.1 and 2.0 kW/ft^2). Calculations were made for three cases: smooth duct with no ribs, ribs on both the guard vessel and collector wall, and ribs on the collector wall only. The results indicate that significant benefits, amounting to nearly two-fold reductions in guard vessel and collector wall temperatures, can be realized by placing repeated ribs on both the guard vessel and the collector wall. The magnitudes of the reduction in the reactor vessel temperature are considerably smaller. In general, the level of improvement, be it with respect to temperature or heat flux, is only mildly affected by changes in rib height or pitch but exhibits greater sensitivity to the assumed value for the system form loss. When the ribs are placed only on the collector wall, the heat removal capability is substantially reduced.

589 **(IAEA-TECDOC—466) Advanced fuel for fast breeder reactors: Fabrication and properties and their optimization. Proceedings of a technical committee meeting held in Vienna, 3-5 November 1987.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1988. 134p. (CONF-8711242—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW.

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

The present design for FBR fuel rods includes usually MOX fuel pellets cladded into stainless steel tubes, together with UO/sub 2/ axial blanket and stainless steel hexagonal wrappers. Mixed carbide, nitride and metallic fuels have been tested as alternative fuels in test reactors. Among others, the objectives to develop these alternative fuels are to gain a high breeding ratio, short doubling time and high linear ratings. Fuel rod and assembly designers are now concentrating on finding the combination of optimized fuel, cladding and wrapper materials which could result in improvement of fuel operational reliability under high burnups and load-follow mode of operation. The purpose of the meeting was to review the experience of advanced FBR fuel fabrication technology, its properties before, under and after irradiation, peculiarities of the back-end of the nuclear fuel cycle, and to outline future trends. As a result of the panel discussion, the recommendations on future Agency activities in the area of advanced FBR fuels were developed. A separate abstract was prepared for each of the 10 presentations of this meeting. Refs, figs and tabs.

590 (IAEA-TECDOC—466, pp 7-23) **Status of (UPu)C and (UPu)N fuel development in BARC.** Ganguly, C.; Hegde, P.V.; Sengupta, A.K. (Bhabha Atomic Research Centre, Bombay (India). Radiometallurgy Div.). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

Plutonium rich (Pu/U+Pu=0.7) mixed uranium plutonium monocarbide (MC) has been used as driver fuel in the fast breeder test reactor (FBTR) in India. Presently, efforts are being made to have a plutonium rich mixed uranium plutonium mononitride (MN) core for FBTR and to develop uranium rich (U/U+Pu=0.8) MC and MN fuels for the forthcoming prototype fast breeder reactor (PFBR) of 500 MWe capacity. In BARC, viable process flowsheets are being developed for commercial scale production of MC and MN via the carbothermic reduction of oxides followed by cold-pelletisation and sintering route. Simultaneously, thermal conductivity and hot hardness data of both plutonium and uranium rich MC and MN are being generated. The out-of-pile chemical compatibility of these fuels with SS 316 cladding and sodium coolant is also being evaluated. The present paper summarises the results of these investigations in BARC during the last two years. (author). 21 refs, 7 figs, 5 tabs.

591 (IAEA-TECDOC—466, pp 25-33) **Fabrication of uranium-plutonium mixed nitride and thermally stable carbide fuels.** Arai, Y.; Fukushima, S.; Shiozawa, K.; Handa, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

Synthesis of uranium-plutonium mixed nitride (U,Pu)N, by carbothermic reduction in a mixed 92%N/sub 2/-8%H/sub 2/ stream was studied on a laboratory scale. UO/sub 2/, PuO/sub 2/ and graphite powders were mixed in a molar ratio, C/(0.8UO/sub 2/+0.2PuO/sub 2/), of 2.2, 2.5, 2.8, 3.1 and 3.5, and carbothermic reduction was performed at 1773 K for 0.2, 0.5, 1, 3, 6, 10 and 20 h. In the early stages of the reduction, oxide, sesquinitride and graphite phases were present besides (U,Pu)N, but they disappeared in the final stage where the weight change obtained was in a good agreement with the calculated value. Present experimental results show that the increase of C/(0.8UO/sub 2/+0.2PuO/sub 2/) ratio aids the rapid removal of oxygen, but results in taking a long time to obtain high purity (U,Pu)N. Thermally stable uranium carbide pellets with low densities were fabricated by using pore former. In the present study, 0.5, 1.0 and 1.5 wt% of the pore former particles with a diameter ranging 10-100 μm were added to UC besides 0.1 wt% of Ni as a sintering aid. The powders were compacted into green pellets without an organic binder under the pressure of 300 MPa, followed by sintering at 1873 K for 3 h in a flow or Ar gas. Bulk density of sintered uranium carbide pellets decreased with an increase of addition of the pore former; i.e. 94, 90 and 87 %TD for 0.5, 1.0 and 1.5 wt% addition of pore former, respectively. Microstructure of the pellets showed that UC matrix phase was fully sintered and spherical pores, not interconnected, were uniformly distributed in the pellets. It was confirmed by the heat-treatment experiments that the present pellets were by far thermally stable compared with those prepared by a conventional method with similar densities. (author). 13 refs, 4 figs, 2 tabs.

592 (IAEA-TECDOC—466, pp 35-42) **Quality control of uranium-plutonium mixed carbide and nitride fuels.** Maeda, A.; Iwai, T.; Ohmichi, T.; Handa, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

The special characterization methods and apparatus developed for the quality control of uranium-plutonium mixed carbide and nitride fuels are described. For the determination of oxygen in carbides, it is very important to prevent the samples from oxygen contamination before loading them into an analyzer. A new sample preparation procedure was developed, i.e., carbides were pulverized, weighed and hermetically pressure sealed immediately into platinum capsules in a high purified argon atmosphere (oxygen and moisture levels less than 2 ppm). It was revealed that even in such a high purified argon atmosphere, fine carbide powders were oxidized with oxygen and moisture. The true oxygen content was successfully estimated by extrapolating the oxygen values determined at various exposure times to zero. The carbon loss via methane gas produced by the reaction of carbides with trace moisture at room temperature was relatively small presumably because of the adsorption of methane on fuel surface. For X-ray diffraction analysis, a sophisticated method was adopted to preserve samples from oxidation during measurement, namely, the mixture of the fuel powder with a small quantity of epoxy resin was mounted on a sample holder in the argon atmosphere. The gas occluded in the fuels was measured by the apparatus with a newly designed gas line filter. For mixed carbide fuels, most of the gases evolved below 1473K was hydrogen. Above this temperature, carbon monoxide equilibrated with oxycarbide was released continuously. An electron probe microanalyzer connected with glove boxes was constructed. About thirty modifications were incorporated to facilitate the repair of the analyzer contaminated with plutonium. (author). 6 refs, 6 figs, 3 tabs.

593 (IAEA-TECDOC—466, pp 43-51) **Mixed nitride fuels fabrication in conventional oxide line.** Bernard, H.; Bardelle, P.; Warin, D. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

UPuN is a strong candidate fuel for advanced liquid metal cooled fast breeder reactors. So far, the main drawback is linked to the difficult and expensive preparation route compared to that of conventional MO/sub 2/ fuels. This paper demonstrates that this difficulty has been overcome: mixed mononitride pellets, with characteristics suitable for an irradiation testing in the PHENIX fast breeder reactor, have been obtained in a classical MO/sub 2/ production facility without any significant modification of the set-up. The synthesis of MN involves the carbothermic reduction of the oxides. The reacted gas, namely CO, are continuously checked by an infra-red detector or a chromatographic gas analyser which allows the sharp control of the chemical conversion MO/sub 2/ -> MN. For consolidation, the granulation step is not necessary; the cold pressing and the oxide type sintering have been adopted. For the pellets to be irradiated in the NIMPHE 1 experiment, values are in the range 0.23-0.07 wt% oxygen and 0.08-0.009 wt% carbon. Sintered densities are in the range 81-84% T.D., with pellets diameter between 5.37 and 5.45 mm, which fits the requirements of radial gap and smear density. Extended analytical procedures, including X-ray analysis, oxygen determination by the inert gas fusion method and carbon titration by the combustion technique, have finally demonstrated the suitability of the fabricated pellets for a first irradiation test of seven CEA UPuN pins, together with four similar EITE pins, now under way in the PHENIX reactor. (author). 8 refs, 3 figs.

594 (IAEA-TECDOC—466, pp 53-59) **Use of carbide-nitride fuel in the USSR. A review.** Majorshin, A.A.; Zabud'ko, L.M.; Bibilashvilij, Yu.K.; Bogatyr, S.M. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

The paper reviews design-experimental work performed to study carbide-nitride fuel serviceability. The principal results are discussed of BR-5, BR-10, BOR-60 investigations into carbide-nitride fuel. (author). 3 refs, 2 tabs.

595 (IAEA-TECDOC—466, pp 61-70) **Fabrication processes and characterization of LMFBR carbide and nitride fuels and fuel pins.** Richter, K.; Blank, H. (Commission of the European Communities, Karlsruhe (Germany, F.R.). European Inst. for Transuranium Elements). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

Fabrication processes for mixed uranium-plutonium carbide and nitride fuels based on carbothermic reduction of oxides, both with subsequent comminution of the reaction product, pressing and sintering, as well as direct pressing of the reacted pellets, are described. The influence of fabrication parameters on fuel composition and properties are given. Results of fuel characterisation by chemical, XRD and ceramographic analysis are discussed with respect to quality control and fuel specification. The data of the He-bonded uranium-plutonium carbide and nitride fuel pins irradiated in the KNKII reactor Karlsruhe, the HFR Petten, and the Phenix reactor at Marcoule, are summarised. (author). 19 refs, 1 fig., 4 tabs.

596 (IAEA-TECDOC—466, pp 71-79) **Performance of He-bonded LMFBR carbide fuels at the beginning of life and consequences for their subsequent behaviour.** Blank, H.; Campana, M.; Coquerelle, M.; Richter, K. (Commission of the European Communities, Karlsruhe (Germany, F.R.). European Inst. for Transuranium Elements). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

The specifications of He-bonded carbide and nitride pellet fuels under current fuel cycle considerations have been discussed several times during recent years. First irradiation experiments with such fuels have been performed in order to study their performance

at the beginning of life. The results of the low burn-up experiments CARRO and CARLO (carbide fuels) will be presented. Based on the experience at low burn-up the performance of this fuel type later in life will be discussed. Calculations with a simple empirical model for the swelling of MX-type fuels will be used to support the discussion. (author). 5 refs, 5 figs, 2 tabs.

597 (IAEA-TECDOC—466, pp 81-95) **Advanced fuel for fast breeder reactors produced by gelation methods.** Alder, H.P.; Ledergerber, G.; Stratton, R.W. (Paul Scherrer Inst. (PSI), Wuerenlingen (Switzerland)). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

The paper outlines two decades of work at EIR covering the development of gelation processes for the production of mixed (U,Pu) nuclear fuels. The programme concentrated initially on the fabrication of uranium-plutonium carbides as an FBR advanced fuel. The requirements of smeared density (75-80% T.D.) permitted the use of 2-size fraction microspheres for vibro-filled fuel pins. The irradiation programme accompanying this work culminated in 1986 in the start of irradiation of 25 sphere-pac carbide fuel-pins in the US Fast Flux Test Facility, alongside US pellet carbide fuel. This test has currently exceeded 3% burn-up with a target of 9%. Associated with the FFTF programme was the development of extensive analytical and QA procedures to characterise the fuel and pins. Additional studies further examined the fuel stoichiometry and phase structure. Code development has also been carried out for the modelling of sphere-pac fuel behaviour. More recently, due to the revival of interest in Europe in mixed nitrides because of their carbide-like behaviour but with improved handling and reprocessing potential, EIR has started to examine a gelation route for the production of (U,Pu)N, based also on carbothermic reduction. Here EIR is collaborating with the CEA (DECPu Cadarache) to develop the gel fabrication process for microspheres or pellets followed by testing under fast reactor conditions. In a first stage the fuel make-up (O, C, N content) is being optimised. For pin fabrication similar techniques can be used as for carbide pins due to the similar requirements of smear density. (author). 12 refs, 5 figs, 3 tabs.

598 (IAEA-TECDOC—466, pp 97-106) **Performance of BOR-60 vibropack uranium-plutonium oxide fuel pins.** Gadzhiev, G.I.; Majorshin, A.A.; Petukhov, A.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

Presented are the results from in-pile tests and material investigations of the BOR-60 vibropack U-Pu oxide fuel pins. The data on fuel pin characteristics are also given. The effects of both the technological factors and test conditions on the fuel pin performance are considered. The factors limiting their service life are revealed and the leads for further improvements of the fuel pin design and fabrication technology to obtain higher burnups are specified. (author). 6 refs, 8 figs, 1 tab.

599 (IAEA-TECDOC—466, pp 107-117) **Present status of FBR mixed oxide and advanced fuel development at PNC.** Endo, H.; Nakajima, I. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Jun 1988. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704483/JAW. (CONF-8711242—).

From Technical committee meeting on advanced fuel for fast breeder reactors: fabrication and properties and their optimization; Vienna, Austria (3 Nov 1987).

The present status of FBR fuel and advanced fuel development in the Power Reactor and Nuclear Fuel Development Corporation (PNC) is given in the paper. PNC has fabricated more than 80 t of mixed plutonium-uranium oxide fuel (MOX) since 1966. Plans for construction of new facilities for MOX fuel fabrication are also presented, as well as their characteristics. There are some plans to develop plutonium metal fuel in PNC facilities. PNC in cooperation with JAERI is developing nitride and carbide fuels for FBRs. (author). 5 figs.

600 **(INIS-SU—52/A) Radiation safety of foreign fast reactors.** Smirnov, V.Yu.; Zakharenkov, V.A. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1987. 85p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704561/JAW.

Current concepts of foreign fast reactor radiation safety are generalized and systematized. The problem is considered in dynamics with regard to FBR and LWR reactor technology interconnection. Analysis of basic provisions and methods for evaluating radiation safety of foreign FBR reactors in operation, under construction and designed ones is given. Experience accumulated by leading Western countries is generalized and investigation directions concerning FBR reactor radiation effect on personnel and population are considered. The review is designed for specialists in the field of nuclear power engineering, biophysicists and radiobiologists. 105 refs.; 13 figs.; 25 tabs.

601 **(KFK—4338) Experimental investigations on the decomposition of methyl iodide in sodium aerosol atmosphere.** Sauter, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jul 1988. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755419/JAW.

This is the final report of the KfK-program named METANA. Because recently the radiological risk of radioiodide release in the case of a LMFBR-HCDA became important again, the state of the art was investigated. In literature, no reliable answer could be found upon the question, what amount of organic radioiodide should be regarded as a sound upper limit in a licensing procedure. This was mainly due to the lack of knowledge of the very likely decomposition of possibly released organic iodide. In order to investigate the decomposition process, an experimental program was performed to characterize the influence of metallic sodium aerosols in an inert atmosphere as well as of sodium fire and the resultant aerosols. One finding was, that at different scenarios the set of important parameters changes. To allow our results to be applied to large containment, those scenarios were selected which could be reproduced and numerically described by empiric formulae. The conditions have been defined under which our suggestions can be applied.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 610

602 **High flux reactor.** Lake, J.A.; Heath, R.L.; Liebenthal, J.L.; DeBoisblanc, D.R.; Leyse, C.F.; Parsons, K.; Ryskamp, J.M.; Wadkins, R.P.; Harker, Y.D.; Fillmore, G.N. (to Dept. of Energy, Washington, DC). US Patent 4,764,339. 16 Aug 1988. Filed date 16 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A high flux nuclear reactor is described comprising: (a) a pressure vessel including reactor coolant inlet means at the first end thereof and reactor coolant outlet means at the second end thereof; (b) a reactor coolant; (c) a first core segment housed within the pressure vessel, the first core segment including a plurality of concentric, circumferential fuel plates, the spacing between the concentric fuel plates forming coolant flow channels, each fuel plate being thin relative to the spacing between the fuel plates; (d) means for stationarily supporting the first core segment from the pressure vessel; (e) a second core segment housed within the pressure vessel and spaced axialy apart from the first core segment such that a coolant mixing plenum is formed therebetween, the second core segment including a plurality of concentric, circumferential fuel plates, the spacing between the concentric fuel plates forming coolant flow channels, each fuel plate being thin relative to the spacing

between the fuel plates; (f) means for stationarily supporting the second core segment from the pressure vessel; and (g) first core coolant bypass means for channeling a volume of the coolant between the inlet means and the coolant mixing plenum such that the coolant volume bypasses the first core segment.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 607, 652, 662, 2419

603 (INIS-mf—11815, pp 405-441) **Procedural law regarding the granting of licenses for nuclear power plants.** Witt, S. de. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The following problems are investigated: basic rights and procedures; overview over the licensing procedure; demur; partial licensing - licensing in different steps - concept licensing - outline permission; amendment to the nuclear procedural order. The following result is ascertained: The nuclear licensing procedure, especially administrative and juridical practices, guarantee full support of those who operate nuclear plants, at the expense of the rights of neighbours. Neighbours are unable in the nuclear licensing procedure to protect their basic rights effectively. (orig./HSCH).

604 (NUREG—0936-Vol.7-No.3) **NRC regulatory agenda: Quarterly report, July-September 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services). Oct 1988. 99p. NTIS, PC A06/MF A01 - GPO. Order Number TI89001768/JAW.

The Regulatory Agenda is a quarterly compilation of all rules on which the NRC has recently completed action or has proposed, or is considering action and of all petitions for rulemaking that the NRC has received that are pending disposition.

605 (NUREG/CR—2000-Vol.7-No.9) **Licensee Event Report (LER) compilation for month of September 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 107p. (ORNL/NSIC—200-Vol.7.No.9). NTIS, PC A06/MF A01 - GPO. Order Number TI89001967/JAW.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-1061, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 - Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System - Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

2108 Economics

REFER ALSO TO CITATION(S) 556, 622, 663

606 (ACIESP—60-Vol.1, pp 19) **Energy, environment in the 21/sup st/ century.** Kondo, J. (Science Council of Japan, Tokyo). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

607 (NUREG/CR—5218) **Financial qualifications review of applicants for nuclear power plant construction permits.** Hendrickson, P.L.; Mullen, M.F.; Carr, D.B. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 77p. (PNL—6632). NTIS, PC A05/MF A01 - GPO. Order Number TI89001662/JAW.

The NRC and its predecessor the AEC have had a regulatory requirement since 1956 that utilities seeking a construction permit for a nuclear power plant be financially qualified to construct and operate the plant. Several amendments to the requirements were made over the years including an attempt in 1982 to drop financial qualification review for electric utilities. This attempt was subsequently found invalid by a federal court. Nevertheless, financial qualification reviews consume significant amounts of NRC staff time and time at Atomic Safety and Licensing Board hearings. The analysis reported in this study was conducted to determine whether there is any empirical evidence of a relationship between a utility's financial health at the time of its construction permits application and the subsequent safety performance of the operating plant. The principal financial measures used to test for this relationship were bond rating, interest coverage ratio, debt/asset ratio, debt/equity ratio, and rate of return on equity. The principal safety measure was the long-term average of the scores assigned the utility in four key areas by the NRC under the Systematic Assessment of Licensee Performance program. The results of the analysis showed no evidence of a relationship between financial health at the time of the construction permit and subsequent safety performance. 7 refs., 16 figs., 4 tabs.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 2656, 2732

608 (IAEA-TECDOC—469, pp 39-48) **Nuclear data for calculation of tritium production in nuclear power reactors.** Drapchinskij, L.V.; Khlebnikov, S.V.; Kovalenko, S.S. (Radievyj Inst., Leningrad (USSR)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

The mechanisms of tritium production and the current status of nuclear data for calculation of tritium production in nuclear power reactors are described. it is concluded that the extended theoretical and experimental investigations on the ternary fission and (n,/sup 3/H) reactions are needed. (author). 36 refs, 4 figs, 5 tabs.

609 (JAERI-M—88-119) **Vectorization of a three dimensional thermal-hydraulic analysis code 'STREAM'.** Kunugi, Tomoaki; Yokokawa, Mitsuo; Chiba, Takemi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 87p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755220/JAW.

This paper describes the vectorization of a thermal-hydraulic analysis code 'STREAM', which can solve the three-dimensional timedependent incompressible Navier-Stokes equations, the energy and the concentration equations for the laminar flows, and can use

the k-ϵ model of turbulence for the turbulent flows. Computations of the design and the safety evaluation for the HTTR (High Temperature Engineering Test Reactor) in JAERI have been carried out by this code. In consequence of the vectorization, computational time of the vectorized code for sample problems is about 1/20 times that of the original code. Moreover, this paper describes the usage of new functions for the transient analysis.

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 582, 666

610 (IAEA-TECDOC—469, pp 7-9) **Nuclear data requirements.** Manokhin, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

A general review of nuclear data requirements for nuclear power engineering is given. The required nuclear data and the needed accuracy in nuclear data are described. (author). 3 refs.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 523, 645, 890, 1397, 1399, 1461

611 **(EPRI-NP—5928M-Vol.1) Supplementary examination of alterative materials in a model steam generator: Volume 1, Tubesheet and tube bundle examinations: Final report.** Krupowicz, J.J.; Silva, E.J.; Fink, G.C.; Hall, J.F. (Electric Power Research Inst., Palo Alto, CA (USA); Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). Oct 1988. 23p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89002057/JAW.

The results of the destructive examination of tubesheet segments and supplementary tube bundle alternative materials from the model 10 steam generator are presented. The test model was fabricated of A600, A690, and A800 nuclear grade (NG) heat transfer tubes, support structures of various materials and designs, and an A508 class 3 tubesheet. Subsequently, the unit was steamed for approximately one year faulted with about 40-ppM sulfate from a simulated cooling tower water to rank alternative materials. The results are not necessarily a measure of predicted performance. 3 refs., 1 fig., 2 tabs.

612 **(JAERI-M—88-124) Development of ADINA-J-integral code.** Kurihara, Ryoichi. (Science and Technology Agency, Tokyo (Japan)). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 58p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755224/JAW.

A general purpose finite element program ADINA (Automatic Dynamic Incremental Nonlinear Analysis), which was developed by Bathe et al., was revised to be able to calculate the J- and J-integral. This report introduced the numerical method to add this capability to the code, and the evaluation of the revised ADINA-J code by using a few of examples of the J estimation model, i.e. a compact tension specimen, a center cracked panel subjected to dynamic load, and a thick shell cylinder having inner axial crack subjected to thermal load. The evaluation testified the function of the revised code.

613 **Experimental validation of models applicable to the ultrasonic inspection of nuclear components.** Newberry, B.P.; Margetan, F.J.; Thompson, R.B. (Iowa State Univ., Ames (USA)). pp 1745-1752 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Two models were evaluated for their accuracy in predicting the results of proposed ultrasonic inspection techniques. The first was the Gauss-Hermite beam model for simulating the evolution of ultrasonic field patterns as the beam propagates from the transducer into a component. The second was a crack scattering model designed to predict the ultrasonic inspection response of a branched crack as an idealization of an intergranular stress corrosion crack. Beam profiles and crack responses are plotted.

614 **Human factors impact on NDE reliability.** Spanner, J.C. (Pacific Northwest Lab., Richland, WA (USA)). pp 1791-1798 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC06-76RL01830.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A feasibility study was conducted to quantify the human factors involved in reactor component NDE reliability and to establish ground rules and recommendations for a testing program aimed at improving the performance of NDE personnel. The study had these objectives: to identify and characterize human factors aspects pertinent to ultrasonic testing/inservice inspection (UT/ISI) processes; to develop a model for the UT/ISI man-machine system; to evaluate methods for measuring and analyzing NDE performance; and to acquire and evaluate human factors data during a round robin test of UT effectiveness in detecting intergranular stress corrosion cracking in nuclear reactor piping specimens. Relative operating characteristic curves derived from the evaluation are plotted.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 124, 893, 986

615 **(KFK—4420) Two-dimensional finite element method for analysis of solid body contact problems in fuel rod mechanics.** Nissen, K.L. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Jun 1988. 138p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755424/JAW.

Two computer codes for the analysis of fuel rod behavior have been developed. Fuel rod mechanics is treated by a two-dimensional, axisymmetric finite element method. The program KONTAKT is used for detailed examinations on fuel rod sections, whereas the second program METHOD2D allows instationary calculations of whole fuel rods. The mechanical contact of fuel and cladding during heating of the fuel rod is very important for it's integrity. Both computer codes use a Newton-Raphson iteration for the solution of the nonlinear solid body contact problem. A constitutive equation is applied for the dependency of contact pressure on normal approach of the surfaces which are assumed to be rough. If friction is present on the contacting surfaces, Coulomb's friction law is used. Code validation is done by comparison with known analytical solutions for special problems. Results of the contact algorithm for an elastic ball pressing against a rigid surface are confronted with Hertzian theory. Influences of fuel-pellet geometry as well as influences of discretisation of displacements and stresses of a single fuel pellet are studied. Contact of fuel and cladding is calculated for a fuel rod section with two fuel pellets. The influence of friction forces between fuel and cladding on their axial expansion is demonstrated. By calculation of deformations and temperatures during an instationary fuel rod experiment of the CABRI-series the feasibility of two-dimensional finite element analysis of whole fuel rods is shown.

616 **Method and apparatus for diagnosing breached fuel elements.** Gross, K.C.; Lambert, J.D.B.; Nomura, S. US Patent Application 6-020-997. 2 Mar 1987. 32p. Contract W-31109-ENG-38. NTIS, PC A03/MF A01.

The invention provides an apparatus and method for diagnosing breached fuel elements in a nuclear reactor. A detection system measures the activity of isotopes from the cover gas in the

reactor. A data acquisition and processing system monitors the detection system and corrects for the effects of the cover-gas clean up system on the measured activity and further calculates the derivative curve of the corrected activity as a function of time. A plotting system graphs the derivative curve, which represents the instantaneous release rate of fission gas from a breached fuel element. 8 figs.

2204 Control Systems

REFER ALSO TO CITATION(S) 616, 630, 666

617 **(EPRI-NP—6067-Vol.1) Surveillance of instrumentation channels at nuclear power plants: Volume 1, Methods for reducing costs: Final report.** Thie, J.A. (Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1988. 78p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001759/JAW.

Surveillance activities at nuclear plants include calibrations, functional tests, and simple checks. Because these are costly in manpower, radiation exposure, and risks from the surveillance themselves, a study was performed to find methods not traditionally used which might be cost-beneficial in these activities. From a, primarily literature, survey of both nuclear and other industries, a list of such methods has been compiled. These were found to fall into categories of hardware, software, human factors, surveillance interval optimization, group interactions, and instrument-specific approaches or devices. As the methods range from fully developed to just emerging from R&D, some may require validation. Six validation techniques are described. A Delphi survey was conducted among 15 highly experienced instrumentation and control experts to evaluate the methods. A ranking of methods in the order of their preferences resulted. Also found are the considerations they used in the order of importances they assigned. Bias in making judgments based on prior knowledge and experience with methods was investigated as a very significant factor. In making their assessments, the advisory group also made annual costs and savings estimates. It is expected that these results will guide utilities and EPRI in directions to take in improving surveillance testing at nuclear plants.

618 **(JAERI-M—88-113) Safety design of NSRR instrumentation and control systems for the improved pulsing operation.** Inabe, Teruo; Ishijima, Kiyomi; Tanzawa, Sadamitsu and others. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jun 1988. 61p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755217/JAW.

In the Nuclear Safety Research Reactor (NSRR), inpile experiments have been conducted to study the fuel behavior under reactivity-initiated accident (RIA) conditions. The simulation of an RIA in the present NSRR operation is done by generating a sharp pulsed power with a peak value of up to 23,000 MW from an initial low power level of less than 1 kW (this type of operation is referred to as "Natural Pulse Operation"). On the other hand, the simulation of an RIA from a high power level and the simulation of a slower abnormal power transient are required to expand the experimental capability of the NSRR for the future research programs. The former will be done by combining the generation of a high power of up to 10 MW and the generation of a sharp pulsed power with a peak value of up to 23,000 MW (this type of operais referred to as 'Combined Pulse Operation'). The latter will be done by generating a transient power of up to 10 MW in an arbitrary shape (this type of operation is referred to as 'Shaped Pulse Operation'). A significant modification of the reactor instrumentation and control systems of the NSRR is prerequisite for achieving the improved pulsing operations of these types, and therefore, the design works were developed as to the equipments for reactor instrumentation, control and safety protection together with the technical examinations of the new type operations from the safety point of view. On the basis of these works, the safety design of the instrumentation and control systems of the NSRR has been established. This paper presents the principle ideas for the safety design, the methodology of the new type pulsing operations, the fundamental design of the reactor instrumentation and control systems, and the predicted major reactor kinetics in the new type operations. Through the safety design presented herein, a fair prospect of realizing the safe and stable conduct of the improved pulsing operations has been obtained.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 604, 657, 658, 1970

619 **(DOE-RW—88.033) Atmospheric dispersion modelling and the use of radiological data in the event of a nuclear accident overseas.** ApSimon, H.M.; Simms, K.L. (Imperial Coll. of Science and Technology, London (UK). Dept. of Mechanical Engineering). (Department of the Environment, London (UK)). Feb 1988. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755239/JAW.

This report considers what radiological measurements are most useful for use in conjunction with computer simulations based on meteorological data to provide the best possible estimates of areas affected and the likely levels of contamination in the event of a nuclear accident overseas. The context is defined according to the needs at different stages in emergency procedures - before radioactivity reaches the UK, during the period of passage overhead, after passage of the material. The ability to identify localised areas where precipitation has concentrated deposition is emphasized. It is made clear that γ detectors tend to be dominated by local levels of deposited activity and are inadequate to define when radioactivity is passing overhead. Facilities for airborne monitoring are recommended.

620 (STUK-A—55, pp 75-93) **Dose assessment. Chapter 5.** Blomqvist, L; Paakkola, O.; Suomela, M. Jun 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780019/JAW.

In Studies on environmental radioactivity in Finland in 1986. Annual report.

In the beginning of 1986, the fallout from nuclear weapons tests carried out in the past was decreasing, almost approaching the detection limit. The total dose delivered in 1986 could be estimated to be less than 10 μSv. The accident in the nuclear power plant at Chernobyl on April 26 led to an extensive fallout in southern Finland during the first two weeks of May. The external dose rate due to the fallout reached 5 μSv h/sup -1/ in some locations - an increase over normal background by a factor of 30-40. At the time the growing season was only beginning, and in the main fallout areas the ground was still frozen and partly covered with snow. Comparison of this fallout with the world wide fallout from nuclear weapons tests during 1945-1985 revealed that the amounts of radionuclides released in nuclear explosions were substantially higher than those from Chernobyl. However, the fallout of cesium 137 in Finland was nearly four times higher than that from nuclear tests.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 618, 635, 637, 1206, 1546

621 (ACIESP—60-Vol.1, pp 7) **Nuclear research reactor IEA-R1 operation and utilization.** Dilquez, J.A.D. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

622 **(IAEA-TECDOC—467) Standardization of specifications and inspection procedures for LEU plate-type research reactor fuels. Report of a consultants' meeting held in Geesthacht, Federal Republic of Germany, 16-18 April 1986.** (International Atomic Energy Agency, Vienna (Austria)). Jun 1988. 36p. (CONF-8604403—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704337/JAW.

From Consultants' meeting on standardization of specifications and inspection procedures for LEU plate-type research reactor fuels; Geesthacht, F.R. Germany (16 Apr 1986).

With the transition to high density uranium LEU fuel, fabrication costs of research reactor fuel elements have a tendency to

increase because of two reasons. First, the amount of the powder of the uranium compound required increases by more than a factor of five. Second, fabrication requirements are in many cases nearer the fabrication limits. Therefore, it is important that measures be undertaken to eliminate or reduce unnecessary requirements in the specification or inspection procedures of research reactor fuel elements utilizing LEU. An additional stimulus for standardizing specifications and inspection procedures at this time is provided by the fact that most LEU conversions will occur within a short time span, and that nearly all of them will require preparation of new specifications and inspection procedures. In this sense, the LEU conversions offer an opportunity for improving the rationality and efficiency of the fuel fabrication and inspection processes. This report focuses on the standardization of specifications and inspection processes of high uranium density LEU fuels for research reactors. However, in many cases the results can also be extended directly to other research reactor fuels. 15 refs, 1 fig., 3 tabs.

623 **(JAERI-M—88-128) Measurement of decay heat from spent fuel assemblies of JPDR and JMTR.** Murakami, Kiyonobu; Kobayashi, Iwao. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 21p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755228/JAW.

The radiation decay heat from spent fuel assemblies are important design data for transportation casks, spent fuel storage systems. In order to prove the possibility to measure the decay heat, a thermal power measuring device was developed. The device consisted of two chambers for a spent fuel assembly and a calibration heater. The two chambers were connected by a pipe line, and contained water which was circulated by a pump. The thermal power, 8 watt, generated from a spent fuel assembly of JPDR could be measured from the relation between the thermal power generated from the calibration heater and saturated temperature difference in the circulation loop. Furthermore, the decay heat behavior for spent fuel assemblies unloaded from JMTR was measured for the interval three weeks through five months after shutdown of the reactor.

624 **(JAERI-M—88-134) Experimental study of falling water limitation under counter-current flow in the vertical rectangular channel. CCFL correlation for rectangular channel.** Usui, Tohru; Kaminaga, Masanori; Sudo, Yukio. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 34p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755230/JAW.

Quantitative understanding of critical heat flux (CHF) in the narrow vertical rectangular channel is required for the thermo-hydroulic design and the safety analysis of research reactors in which flat-plate-type fuel is adopted. Especially, critical heat flux under low downward velocity has a close relation with falling water limitation under counter-current flow. Accordingly, CCFL (Counter-current Flow Limitation) experiments were carried out for both vertical rectangular channels and vertical circular tubes varried in their size and configuration of their cross sections, to make clear CCFL characteristics in the vertical rectangular channels. In the experiments, l/de of the rectangular channel was changed from 3.5 to 180. As the results, it was clear that different equivalent hydraulic diameter de, namely width or water gap of channel, gave different CCFL characteristics of rectangular channel. But the influence of channel length l on CCFL characteristics was not observed. Besides, a dimensionless correlation to estimate a relation between upward air velocity and downward water velocity was proposed based on the present experimental results. The difference of CCFL characteristics between rectangular channels and circular tubes was also investigated. Especially for the rectangular channels, dry-patches appearing condition was made clear as a flow-map.

625 **On the selection of the optimum design choice for the engineering test reactor: A methodology for making the best rational technical decision.** Perkins, L.J. (Univ. of California, Lawrence Livermore National Lab., P.O. Box 5511, Livermore, CA (US)). *Fusion Technology;* **13**: No. 4, 577-593(May 1988).

A methodology is developed to address two key issues for the Engineering Test Reactor (ETR): (1) How to make the best rational technical decision in selecting the optimum ETR design; (2) What the uncertainty is in this design point due to uncertainties in the system models and input data base used in formulating the design. The methodology provides a framework to reduce complex decision problems for the ETR to a quantitative form that compels us to consider all relevant technical factors and could form the basis of a consensus process for ETR design selection.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 283, 664, 1970

626 **(DPST—87-391-Rev.1) A validation comparison of SHIELD system decay heat calculations to benchmark quality experiments.** Butler, J.C.; Finch, D.R. (Savannah River Lab., Aiken, SC (USA)). 14 Oct 1987. Contract AC09-76SR00001. 26p. NTIS, PC A03/MF A01. Order Number DE89001649/JAW.

The objective of this work was to compare SHIELD system calculations of fission product inventory and decay heat to benchmark quality experiments to provide baseline validation of the calculational methods. This project included expanding the SHIELD system fission product data base to include the ENDF/B-IV fission product data, and modeling the calculated experiments. 9 refs., 14 figs., 4 tabs.

627 **(DPST—88-479) Measurement of pipe vibration during ac-motor startup in p-reactor.** Abramczyk, G.A.; Baumann, N.P. (Savannah River Lab., Aiken, SC (USA)). 16 May 1988. Contract AC09-76SR00001. 39p. (ECS-LOCA—24). NTIS, PC A03/MF A01. Order Number DE89002461/JAW.

Cracking of process water piping is a potential hazard to operation of the SRP reactors. One possible source of cracking, which has been addressed, is fatigue failure due to alternating stresses. Three sources of cyclic stresses have been identified. These are thermal (temperature) cycling, mechanical vibration at steady-state full power operation, and mechanical vibration during the short time interval of switching from dc to ac motor drive for start-up of the process water pumps. The vibration during the start-up transient was known to be severe, but was not quantified. In Reference 1, the stress levels and start-up duration were conservatively estimated. It is the purpose of this report to provide accurate vibrational data for a typical reactor start-up as input to a future stress analysis. The startup for P-10.2 on the morning of February 8, 1988 was selected for the tests. Accelerometers were temporarily located on the horizontal piping above the heat exchangers in System 1, and on vertical sections of the pipe between pump and heat exchanger in system 5. Permanently installed accelerometers were assayed for the remaining systems. The data were recorded on a 4-track FM tape recorder. The tape was later brought back to the laboratory for analysis. This consisted of a FFT (Fast Fourier Transform) analysis to determine precise resonant frequencies and broad band analysis to give the time response. 2 refs., 12 figs., 9 tabs.

628 **(JAERI-M—88-121) CAPSTAR: a program to evaluate safety strength for outer/inner tubes of capusules.** Kobayashi, Toshiki; Hoshiya, Taiji; Niimi, Motoji; Someya, Hiroyuki; Harayama, Yasuo. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 41p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755222/JAW.

The outer/inner tube of a capsule, which contains test specimens in and is loaded in a reactor core for irradiation experiments, is a boundary between its internal materials and the reactor core. Therefore, not to be a injure to the reactor core, the tube is required to calculate induced stresses and to evaluate the safety on its strength. A computer program, named CAPSTAR, to calculate the strength of the outer/inner tubes on safety evaluation was compiled, as a step of improving the efficiency of capsule designs. The

present report describes the calculation method and input/output guides of the CAPSTAR program.

629 **(WHC-SA—0291) Isotope production in the FFTF by neutron transmutation.** Schenter, R.E.; Myjak, M.A. (Westinghouse Hanford Co., Richland, WA (USA)). Dec 1987. Contract AC06-87RL10930. 10p. (CONF-880546—37). NTIS, PC A02/MF A01. Order Number DE89001109/JAW.

From International conference on nuclear data for science and technology; Mito, Japan (30 May 1988).

A calculational study has identified long-lived radioisotopes or rare stable isotopes that can be efficiently produced in the Fast Flux Test Facility. This study was restricted to isotopes produced by neutron transmutation of selected target materials and mainly involves (n,γ) reaction processes. The entire table of isotopes was considered in selecting 441 target/product isotopes for study. There were 25 highly attractive candidates and 91 additional possible candidates identified from these calculations. In addition, information on the application of several of the product isotopes was reviewed, with most of the emphasis in medical areas. Finally, in-depth analyses were made on the present production in the Fast Flux Test Facility of Gd-153 and possible future production of Cf-252. 5 figs., 3 tabs.

630 **Two-dimensional cross-section sensitivity and uncertainty analysis for tritium production rate in fusion-oriented integral experiments.** Ikeda, Y.; Youssef, M.Z. (Japan Atomic Energy Research Institute, Tokai Research Establishment, Dept. of Reactor Engineering, Tokai-mura, Ibaraki-ken 319-11 (JP)). *Fusion Technology;* **13**: No. 4, 616-643(May 1988).

Several integral experiments on tritium breeding were jointly performed in connection with the U.S./JAERI Collaborative Program on Fusion Breeder Neutronics. Tritium production rates from /sup 6/Li (T/sub 6/) and /sup 7/Li(T/sub 7/) were measured at several locations in an Li/sub 2/O assembly embedded in the concrete wall of a 5- x 5- x 4.5-m room (reference experiment) in independent benchmark experiments with the Li/sub 2/O assembly located in a large room of negligible room-return neutrons. In the reference experiment, large discrepancies in T/sub 6/ were found at the front locations in the Li/sub 2/O assembly. At middle locations, the calculated-to-experimental (C/E) values for T/sub 6/ are -- 1.2 (U.S.) and -- 1.1 (JAERI). The C/E values for T/sub 7/ are -- 1.18 (U.S.) and 1.05 (JAERI). To assess the contribution to the uncertainty is predicting T/sub 6/ and T/sub 7/ that results from the current uncertainties in the nuclear data base, an extensive two-dimensional cross-section sensitivity/uncertainty analysis was performed. For that purpose, the FORSS module, and the VIP and DOT 4.3 codes were used along with the PUFF-2 covariance code. Two systems were considered for the analysis: the benchmark system and the reference system. The models used simulate the geometrical details and source conditions for the experiments.

2208 Propulsion Reactors

631 **High-temperature silicon-on-insulator electronics for space nuclear power systems: Requirements and feasibility.** Fleetwood, D.M.; Thome, F.V.; Tsao, S.S.; Dressendorfer, P.V.; Dandini, V.J.; Schwank, J.R. (Sandia National Labs., Albuquerque, NM (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 5, 1099-1112(Oct 1988).

The authors have performed a study to determine whether silicon very-large-scale integrated circuits (VLSICs) can survive the high temperature (up to 300°C) and total-dose radiation environments (up to 10 Mrad over a 7-10 year system life) projected for a very-high-power space nuclear reactor platform. It is shown that circuits built on bulk epitaxial silicon cannot meet the temperature requirement because of excessive junction leakage currents. However, circuits built on silicon-on-insulator (SOI) material can meet both the radiation and temperature requirements. From a study of interface-trap generation and annealing, they find that one cannot depend on the elevated temperatures of a space nuclear power platform to automatically improve MOS total-dose radiation hardness. Still, at high-enough temperatures (above 175°C for these devices) and long enough times postirradiation, device response can be essentially independent of total dose. Reliability and performance issues are also discussed. They find that the temperature dependence of the threshold voltage of the SOI transistors is less than that of bulk transistors. Moreover, the "zero-temperature coefficient" current is much smaller for these "floating-body" SOI devices (— 4 μA) than for bulk devices (— 60 μA). Survivability of high-temperature SOI VLSICs in space, including immunity to transient and single-event upset (SEU), is also addressed. While a large number of practical issues remain to be resolved, no fundamental barrier against the successful development of VLSICs on SOI for use in very-high-power space nuclear reactor systems has been identified.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 543, 577, 587, 619, 1386, 1819

632 **(BNL-NUREG—41719) A risk methodology to evaluate sensitvity of plant risk to human errors.** Samanta, P.; Wong, S.; Higgins, J.; Haber, S.; Luckas, W. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 11p. (CONF-880633—9). NTIS, PC A03/MF A01. Order Number DE89001273/JAW.

From 4. international conference on human factors and power plants; Monterey, CA, USA (5 Jun 1988).

This paper presents an evaluation of sensitivity of plant risk parameters, namely the core melt frequency and the accident sequence frequencies, to the human errors involved in various aspects of nuclear power plant operations. Results are provided using the Oconee-3 Probabilistic Risk Assessment model as an example application of the risk methodology described herein. Sensitivity analyses in probabilistic risk assessment (PRA) involve three areas: (1) a determination of the set of input parameters; in this case, various categories of human errors signifying aspects of plant operation, (2) the range over which the input parameters vary, and (3) an assessment of the sensitivity of the plant risk parameters to the input parameters which, in this case, consist of all postulated human errors, or categories of human errors. The methodology presents a categorization scheme where human errors are categorized in terms of types of activity, location, personnel involved, etc., to relate the significance of sensitivity of risk parameters to specific aspects of human performance in the nuclear plant. Ranges of variability for human errors have been developed considering the various known causes of uncertainty in human error probability estimates in PRAs. The sensitivity of the risk parameters are assessed using the event/fault tree methodology of the PRA. The results of the risk-based sensitivity evaluation using the Oconee-3 PRA as an example show the quantitative impact on the plant risk level due to variations in human error probabilities. The relative effects of various human error categories and human error sorts within the categories are also presented to identify and characterize significant human errors for effective risk management in nuclear power plant operational activities. 8 refs., 10 figs., 4 tabs.

633 **(CLM-R—282) Large scale mixing calculations.** Fletcher, D.F. (UKAEA Culham Lab., Abingdon). Jan 1988. 24p. H.M. Stationery Office, London, price Pound 4.00.

The coarse mixing stage of a vapour explosion has attracted a considerable amount of interest in the study of hypothetical reactor accidents. Numerous models of this process have been developed. This paper contains a description of some large scale coarse mixing calculations and the results obtained using the CHYMES computer code. Exactly the same calculations are being performed by different workers using their own models. The aim of this work is to compare the results obtained from each of the codes and to examine the validity of the different assumptions made in the different models.

634 **(CLM-R—283) Multiphase flow simulations of shocks and detonations.** Fletcher, D.F.; Thyagaraja, A. (UKAEA Culham Lab., Abingdon). Feb 1988. 26p. (MFCIWP—88-P63). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755238/JAW.

In this paper we present an extension of the model described in parts I and II of this investigation. We have added further equations to the model to enable us to study droplet laden gas flows. Results are presented for cases with and without fragmentation and are compared with the analytic theory which is valid in the limit of small particle size.

635 **(CONF-880760—6) Application of CT filter algorithms to digitized film data.** Morman, J.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 20p. NTIS, PC A03/MF A01. Order Number DE89000520/JAW.

From Review of progress in quantitative nondestructive evaluation; La Jolla, CA, USA (31 Jul 1988).

The CT studies performed thus far in the RAS division have been based on neutron radiographs of two 7-pin reactor fuel bundles which were subjected to over-power accident simulations in the TREAT reactor. The tests as referenced below were named L05 and L06. As a result of the tests, the pins were severely damaged, with molten fuel and steel spreading throughout the fuel assembly. After removal of parts of the test vehicle, the remaining assembly is approximately 2 m long, and less than 10 cm diameter. The neutron radiographs are produced at the NRAD reactor facility at ANL-West in Idaho. The beam port used for the radiography is shaped to a rectangular opening of 43.2 by 25.4 cm. The standard foil cassette is approximately this same size, and a near-parallel-beam geometry is achieved with only a 1.5% magnification factor. 1 ref., 16 figs., 1 tab.

636 **(CONF-881210—1) RVACS/RACS [reactor vessel auxiliary cooling system/reactor air cooling system] shutdown heat removal in a modular sized LMR [liquid metal reactor].** Dunn, F.E.; Wigeland, R.A.; Lo, R.K. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88009978/JAW.

From ASME winter annual meeting; Chicago, IL, USA (1 Dec 1988).

Shutdown heat removal by a RVACS for an unprotected loss of flow case in a modular sized LMR has been analyzed with the SASSYS-1 LMR systems analysis code. For this case it was assumed that all power was lost to the primary and intermediate sodium pumps, and feedwater flow to the steam generators was lost. The control rods failed to scram, but reactivity feedback shut down the power to decay heat levels. The only heat removal was by sodium natural circulation from the core to the vessel wall and by cooling of the vessel wall by radiation and air natural circulation in the Reactor Air Cooling System. The case was run until the system temperatures peaked when the decay heat power level dropped below the heat removal rate.

637 **(DOE/NE/37970—T5-Add.) An eight pushbutton control system for the PSU ultra-safe nuclear plant: Addendum to annual report.** Schultz, M.A. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Oct 1988. Contract AC02-86NE37970. 120p. NTIS, PC A07/MF A01. Order Number TI89001879/JAW.

The control system described in this report was developed for a "Light Water Ultra-Safe Plant Concept" studied at Penn State during a 2 year program funded by the Department of Energy. A reconfigured pressurized water reactor was designed which eliminated the conventional PWR pressurizer and added an active pumping system with a large dedicated water storage tank to control pressure. The thermal hydraulics aspects of the design were studied and reported in several master's theses and other addendum reports and first annual report. In addition to improving the inherent safety of an advanced plant by changes in the thermal hydraulic aspects of the design, a new approach to control system organization and design should also be included in an advanced plant. The study presented in this report modifies a conventional PWR plant control system to the needs of the Ultra-Safe Plant Concept and then describes implementation of the control system in a distributed network of control computers. The end result is a control system that is much simpler at the operator level. This simplicity should eliminate the possibility of operator error in the Ultra-Safe plant.

638 **(DPST—88-628) Reactor cooling following a postulated seismic induced loss of electric power.** Baker, W.H. (Savannah River Lab., Aiken, SC (USA)). Jun 1988. Contract AC09-76SR00001. 10p. NTIS, PC A02/MF A01. Order Number DE89002460/JAW.

A seismic event has been postulated to cause loss of site power, and subsequent loss of cooling water flow to the 100 Areas, for a period of 72 hours. It is further postulated that the emergency power system in the reactor building is disabled. This report evaluates the capability of the 25,000,000 gallon 186 Basin to provide reactor cooling during the 72 hour period before site power is restored. 5 refs., 1 fig., 4 tabs.

639 **(EGG-M—88217) The analysis of plant transients defines safety margins and accident management strategies.** Duffey, R.B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 6p. (CONF-881115—3). NTIS, PC A02. Order Number DE88015186/JAW.

From 3. international topical meeting on nuclear power plant thermal hydraulics and operations; Seoul, Korea (14 Nov 1988).

Developments in system analysis and simulation are described which cover the application to training, uncertainty determination, survivability and accident management. 6 refs., 7 figs.

640 **(ENEA-RT-PAS—87-19) Dynamic transfer model by means of experimental data collected after Chernobyl accident, for evaluating some parameters concerning the radioactive migration in the environment. Pt.1.** Monte, L. (ENEA, Casaccia (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1988. 22p. (In Italian). (CONF-8709369—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704427/JAW.

From 4. meeting of the Italian Society for Radiation Research; Santa Teresa, Italy (15 Sep 1987).

Using the environment contamination data collected during the Chernobyl accident, some important parameters for assessing the environmental transfer of /sup 131/I and /sup 137/Cs in dynamical conditions are determined.

641 **(EPRI-NP—3878-Vol.1) Large-scale hydrogen combustion experiments: Volume 1, Methodology and results: Final report.** Thompson, R.T.; Torok, R.C.; Randall, D.S.; Sullivan, J.S.; Thompson, L.B.; Haugh, J.J. (Electric Power Research Inst., Palo Alto, CA (USA); EG and G Energy Measurements, Inc., Las Vegas, NV (USA); ASTRON Research and Engineering, Sunnyvale, CA (USA)). Oct 1988. 623p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001773/JAW.

Forty large-scale experiments to investigate the combustion behavior of hydrogen during postulated degraded core accidents were conducted in a 16 m (52 ft) diameter sphere. The performance of safety related equipment and cable also was examined. Combustion was initiated by thermal igniters in both premixed hydrogen-air-steam atmospheres and during the continuous injection of hydrogen and steam. The effects of steam, igniter location, water sprays, fans and injection rates were studied. Measurements were made of gas concentrations, combustion pressures, temperatures and heat fluxes. Burn fractions and flame speeds also were determined. Near-infrared seeing cameras permitted direct observation of the hydrogen burns. Combustion pressures and temperatures in premixed atmospheres with hydrogen concentrations up to 13 vol% (steam saturated) were less than the theoretical maximum values. Multiple deflagrations were not encountered during continuous hydrogen injection with pre-activated igniters. Moderate pressure rises resulted from diffusion flames. These flames generally were found above the source. Combustion results have been compared to smaller scale experiments. Several safety related equipment items exhibited degraded performance after a number of tests. Most cable samples passed their electrical checks at the end of the test series. These experiments confirm the effectiveness of the deliberate ignition approach to controlling hydrogen. They also provide data for validating computer codes used to predict hydrogen combustion during degraded core accidents, and for assessing the performance of safety related equipment in such environments. 236 figs., 110 tabs.

642 **(EPRI-NP—3878-Vol.2) Large-scale hydrogen combustion experiments: Volume 2, Data plots: Final report.** Thompson, R.T.; Torok, R.C.; Randall, D.S.; Sullivan, J.S.; Thompson, L.B.; Haugh, J.J. (Electric Power Research Inst., Palo Alto, CA (USA); EG and G Energy Measurements, Inc., Las Vegas, NV (USA); ASTRON Research and Engineering, Sunnyvale, CA (USA)). Oct 1988. 561p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001664/JAW.

Forty large-scale experiments to investigate the combustion behavior of hydrogen during postulated degraded core accidents were conducted in a 16 m (52 ft) diameter sphere. The performance of safety related equipment and cable also was examined. Combustion was initiated by thermal igniters in both premixed hydrogen air-steam atmospheres and during the continuous injection of hydrogen and steam. The effects of steam, igniter location, water sprays, fans and injection rates were studied. Measurements were made of gas concentrations, combustion pressures, temperatures and heat fluxes. Burn fractions and flame speeds also were determined. Near-infrared seeing cameras permitted direct observation of the hydrogen burns. Combustion pressures and temperatures in premixed atmospheres with hydrogen concentrations up to 13 vol% (steam saturated) were less than the theoretical maximum values. Multiple deflagrations were not encountered during continuous hydrogen injection with pre-activated igniters. Moderate pressure rises resulted from diffusion flames. These flames generally were found above the source. Combustion results have been compared to smaller scale experiments. Several safety related equipment items exhibited degraded performance after a number of tests. Most cable samples passed their electrical checks at the end of the test series. These experiments confirm the effectiveness of the deliberate ignition approach to controlling hydrogen. They also provide data for validating computer codes used to predict hydrogen combustion during degraded core accidents, and for assessing the performance of safety related equipment in such environments.

643 **(EPRI-NP—6035) Piping system damping evaluation: Final report.** Hadjian, A.H. (Electric Power Research Inst., Palo Alto, CA (USA); Bechtel Group, Inc., San Francisco, CA (USA)). Oct 1988. 291p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001097/JAW.

The study objectives were to establish for piping systems a uniform damping data base, to identify and quantify the significant parameters that contribute to energy dissipation and to recommend damping values for code adoption. These objectives were achieved through: 1) a detailed evaluation and screening of the existing damping data of piping systems, 2) characterizing of the test items according to their significant physical and response characteristics, modes of excitation and data reduction methods, and 3) developing and use of multivariate regression models. Although several experimental biases were identified that would help explain the large variability of the existing data, these were ignored and only physical attributes were considered for the final study. Because of the distinct differences in light water reactor (LWR) and liquid metal reactor (LMR) piping systems, these groups were segregated and analyzed independently. Several distinct characteristics are identified as important to energy dissipation. For both LWR and LMR piping Diameter and First Mode/Higher Modes differentiation are significant parameters. Additionally for LWR piping, the presence of attached equipment adversely affects damping; guide supports, relative to other types of supports, contribute more to energy dissipation; and damping is related to response level. For LMR piping snubber type supports contribute more to energy dissipation. These effects have all been quantified and damping prediction equations derived for both LWR and LMR piping systems. Since the existing data base is inadequate for certain variables, these identified parameters are not an exhaustive set. A regression analysis can only identify those parameters as significant that have a sufficient number and a wide spectrum of data points. 23 refs., 25 figs., 46 tabs.

644 **(EPRI-NP—6041) A methodology for assessment of nuclear power plant seismic margin: Final report.** Campbell, R.D.; Wesley, D.A.; Henley, B.F.; Johnson, J.J.; Buttemer, D.R.; McIntyre, T.; Bley, D.; Kennedy, R.P.; Moriwaki, Y.; Idriss, I.M.; Chang, C.Y.; Shoemaker, W.; Kulla, D. (Electric Power Research Inst., Palo Alto, CA (USA); NTS Engineering, Long Beach, CA (USA); RPK Structural Mechanics Consulting, Yorba Linda, CA (USA); Pickard, Lowe and Garrick, Inc., Newport Beach, CA (USA); Woodward Clyde Consultants, Santa Ana, CA (USA); Duke Power Co., Charlotte, NC (USA)). Oct 1988. 569p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001529/JAW.

In recent years, increasing knowledge in the geoscience field has led to a better understanding that, although highly unlikely , it is possible for a nuclear power plant to be subjected to earthquake ground motion greater than that for which the plant was designed. There is a concern that there may be an upper shelf of seismic capacity, primarily for active equipment, which would render components inoperable if exceeded. For this reason, interest has developed in defining the margin above the Safe Shutdown Earthquake (SSE) that exists in operating plants. While defining this margin is a desirable goal, it is much more practical to select an earthquake level for which survivability is to be demonstrated for only those systems and components which are required to bring the plant to, and maintain, a safe shutdown condition following the seismic event. The earthquake level for which survivability is to be demonstrated is commonly referred to as the Seismic Margin Earthquake (SMW). This is not a new design earthquake. It is an earthquake for which existing plants may be required to demonstrate survivability. The principal objective of this research project was to define such new, practical approaches and criteria that are, for the most part, usable by utility staff to assess their plant for a seismic event larger than the SSE. A further objective was to develop approaches and criteria that are compatible with those being developed to resolve other generic safety issues.

645 **(GKSS—88/E/1) Scientific-technical reports of the GKSS 1987.** (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1988. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755279/JAW.

This review of the scientific results contains the names of the authors and the titles of all the external GKSS-reports ('E-reports') edited in 1987. From these reports there are presented abstracts and/or bibliographic data - unless they have been published as reprints of articles in journals or special prints of contributions to conference reports or monographies.

646 **(GRS-F—164) Reports on research programs in the field of reactor safety sponsored by the Federal Ministry for Research and Technology. Reported period: July 1 - December 31, 1987.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jun 1988. 401p. (In German). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755280/JAW.

Each progress report represents a compilation of individual reports about objectives, the work performed, the results, the next steps of the work etc. The individual reports are prepared in a standard form by the contractors themselves as a documentation of their progress in work and published by the FB Forschungsbetreuung (research coordination department) at the GRS, within the framework of general information of progress in reactor safety research. The individual reports are classified according to the research program on the safety of LWR 1977-1980 of the BMFT. Another table of contents uses the same classification system as applied in the nuclear safety index of the CEC (Commission of the European Communities) and the OECD (Organization for Economic Cooperation and Development). The reports are arranged in the sequence of their project numbers.

647 **(GRS-F—165) Annual report on reactor safety research projects sponsored by the Ministry for Research and Technology of the Federal Republic of Germany 1987. Progress report.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jun 1988. 391p. NTIS (US Sales Only), PC A17/MF A01. Order Number DE88755158/JAW.

The GRS (Reactor Safety Association), Gesellschaft fuer Reaktorsicherheit mbH, by order of the BMFT, informs continuously of the status of such investigations by means of semi-annual and annual publication of progress reports within the series GRS-F-Fortschrittsberichte (GRS-F-Progress-Reports). Each progress report represents a compilation of individual reports about objectives, the work performed, the results, the next steps of the work etc. The individual reports are prepared in a standard form by the contractors themselves as a documentation of their progress in work and published by the FB (Research Coordination Department), Forschungsbetreuung at the GRS, within the framework of general information of progress in reactor safety research. The individual reports are classified according to the Research Program on the Safety of LWRs of the BMFT. Another table of contents uses the same classification system as applied in the Nuclear Safety Index of the CEC (Commission of the European Communities) and the OECD (Organization for Economic Cooperation and Development). The report are arranged in the sequence of their project numbers.

648 **(GRS-F—166) Surveys of research projects concerning nuclear facility safety, financed by the Federal Ministry for the Environment, Nature Protection and Reactor Safety, 1987. 12. annual report on SR-projects.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jun 1988. 259p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88755281/JAW.

Each progress report is a collection of individual reports, categorized by subject matter. They are a documentation of the contractor's progress, rendered by themselves on standardized forms, published, for the sake of general information on progress made in investigations concerning reactor safety, by the project attendance department of the GRS. The individual reports have serial numbers. Each report includes particulars of the objective, work carried out, results obtained and plans for project continuation.

649 **(GRS-F—167) List of reports from the field of reactor safety research sponsored by BMFT, CEA, EPRI, JSTA and USNRC. Reporting period: January 1 to March 31, 1988.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). May 1988. 50p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755159/JAW.

The list reviews reports form the Federal Republic of Germany, from France, from Japan and from the United States of America concerning single problems in the field of reactor safety research. According to the cooperation of the Federal Minister for Research and Technology (BMFT) with the Commissariat a l'Energie Atomique (CEA), the Japan Science and Technology Agency (JSTA), the Electric Power Research Institute (EPRI) and the United States Nuclear Regulatory Commission, these reports are available from the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned according to the Reactor Safety Research Programme of the BMFT, reporting organization. The list of reports appears quarterly.

650 (INIS-mf—11312, pp 227-231) **Prospects of remelting metal materials from shutdown nuclear power installations.** Jamrich, J.; Soos, F. 1987. (In Slovak). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The remelting of metal materials from decommissioned nuclear power installations may be used to reduce the volume of wastes, to fix radioactivity by building contaminated wastes into matrices with extremely low leachability and immense mechanical strength or by building them into the slag phase, to extract radionuclides from melted metal into slag, to recycle the metal, e.g., by reducing the contents of radionuclides by dilution below the level set by hygiene regulations. Metal recycling, especially the recycling of stainless steels is a very topical problem in the Czechoslovak nuclear programme. This mainly concerns reducing the concentration of radionuclides, converting /sup 60/Co and precipitating /sup 137/Cs in the slag to below the levels permitted by hygiene regulations. Briefly described are remelting methods used by the British Steel Corporation, Siempekamf Guss- und Reaktortechnik and Seri-Renault. (Z.S.). 1 tab., 6 refs.

651 (INIS-mf—11815, pp 206-262) **Recent findings on the course and consequences of hypothetical core meltdown accidents in PWR type reactors.** Hosemann, J.P. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

More recent results of analyses conducted over several years to determine the actual course of a core meltdown indicate that the consequences of accidents were considerably overrated in earlier basic investigations, such as the 'Deutsche Risikostudie - Kernkraftwerke', phase A. The probability of a core meltdown accident occurring is extremely and unillustratively small. Of the imaginable courses of accidents involving rupture of main coolant pipes and failing emergency cooling systems, the one termed as excursion category (FK) 6 is the most likely. The accident that would have the severest consequences but whose likelihood is so much smaller is termed FK2. In a summary, the new results (1982) of the PNS project (Project Nuclear Safety) from the Kernforschungszentrum Karlsruhe are once more contrasted for both excursion categories with those of the 'Deutsche Risikostudie'. (orig./HSCH).

652 (INIS-mf—11815, pp 263-279) **Safety studies - basic safety - a safety philosophy.** Kohler, S. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

A crucial component of any nuclear power plant, to be considered in the discussion about safety risks, is the reactor's pressure vessel. Apart from possible failures of the components of the primary cooling cycle, the fact that there exists only one pressure vessel of the reactor also carries negative implications. Thus, the possibility of the reactor's pressure vessel bursting led to a court order suspending building works in the court proceedings about the Wyhl nuclear power plant. The 'Deutsche Risikostudie - Kernkraftwerke' (DRS) established 1 x 10/sup -7/ as the frequency of incidence of a nuclear accident involving the bursting of the reactor's pressure vessel. The theoretical concept of 'basic safety' serves to ward off any doubts in this respect. It argues that the use of optimized materials and process techniques in the construction of component parts have created a situation where no more failures relevant so safety will occur. Although things are different in practice, the nuclear industry stays calm. (orig./HSCH).

653 (INIS-mf—11815, pp 280-299) **German study on the risks of nuclear power plants.** Wollny, V. (Oeko-Institut, Inst. fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany, F.R.)). 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The 'Deutsche Risikostudie Kernkraftwerke', DRS, (German study on the risks of nuclear plants) calculates a frequency of 1/

10000 years (i.e. once in 10000 years of reactor operation) for the event of insufficient cooling of the reactor core occurring. The resulting collective risk is put at approximately 10 deaths per year for 25 plants. As the explanations show, the error margin of such a risk statement is enormous. Moreover, much seems to indicate that the risk was underrated. Apart from this, risk analyses are of doubtful value in the decision process for or against the introduction of large-scale technologies. They cannot replace the individual decision of all concerned. (orig./HSCH).

654 **(JAERI-M—88-125) Evaluation report on SCTF core-III test S3-SH1. Effect of hot leg injection on core thermal-hydraulics for PWR's with a combined injection type ECCS.** Iwamura, Takamichi; Iguchi, Tadashi; Akimoto, Hajime; Okubo, Tsutomu; Ohnuki, Akira; Sakaki, Isao; Adachi, Hiromichi; Murao, Yoshio. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 134p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755225/JAW.

In order to investigate the thermal-hydraulic characteristics in the core for PWR's with a combined injection type ECSS, a core cooling base case test (S3-SH1) was performed using the Slab Core Test Facility (SCTF) Core-III. Subcooled ECC water was injected into the upper plenum simulating a hot leg injection under evaluation model (EM) condition. Thermal-hydraulic behavior in the core was separated into two regions; a water down-flow region and an up-flow region, corresponding to the non-uniform ECC injection. A significant circulating flow was observed in the core and resultantly the effective flooding velocity was increased in the up-flow region. Before the initiation of bottom reflood, the water down-flow region was significantly cooled while the up-flow region was slightly cooled. After that time, the heat transfer coefficient in the up-flow region was approximately two times higher than a predicted value with a Bromley-type film boiling heat transfer correlation which was successfully applied to a cold leg injection mode. On the other hand, the heat transfer coefficient was predicted well with dispersed flow heat transfer correlations.

655 **(KFK—4450) Safety-oriented LWR research. Annual report 1987.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projektgruppe LWR-Sicherheit). Jun 1988. 319p. (In German). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88755425/JAW.

The annual report 1987 includes the results of out-of-pile bundle experiments for severe fuel damage investigations (CORA), aerosol behaviour under core meltdown accident condition, dynamic behaviour of PWR containments, theoretical and experimental investigations of crack growth under thermal and thermomechanical fatigue loading, the thermal hydraulic code COMMIX-1B, the interfacial exchange processes in two-phase flow (NOVA-Program), the retention of penetrating iodine species, the development of exhaust filters and HEPA filter systems, advanced PWR's (APWR's) and related safety considerations, the HERA test facility and the KRISTA-program, and RELAP5/MOD2 post-test analysis of a forced feed reflood experiment. 20 papers are separately indexed in the database.

656 **(LA-UR—88-3348) Modeling of the TMI-2 [Three Mile Island Unit-2] accident with MELPROG/TRAC and calculation results for Phases 1 and 2.** Motley, F.E.; Jenks, R.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 23p. (CONF-881024—5). NTIS, PC A03/MF A01. Order Number DE89002039/JAW.

From TMI-2 accident materials behavior, plant technology and recovery; Washington, DC, USA (30 Oct 1988).

Work has been performed to develop a Three Mile Island Unit-2 (TMI-2) simulation model for MELPROG/TRAC capable of predicting the observed plant behavior that took place during the accident of March 1979. A description of the TMI-2 plant model is presented and calculation results through 174 min of the accident are discussed. Using the ICBC boundary conditions, the calculation predicts pressurizer draining and core recovering prior to fuel-rod damage. A parametric calculation (reduced makeup flow) is currently underway and is in better agreement with the observed plant behavior. Efforts are underway to resolve current discrepancies and proceed with an accurate simulation through Phases 3 and 4 of the accident (174-227 min and 227-300 min, respectively). 13 refs., 11 figs., 2 tabs.

657 **(NUREG—1228) Source term estimation during incident response to severe nuclear power plant accidents.** McKenna, T.J.; Glitter, J.G. (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Oct 1988. 170p. NTIS, PC A08/MF A01 - GPO. Order Number TI89002115/JAW.

This document presents a method of source term estimation that reflects the current understanding of source term behavior and that can be used during an event. The various methods of estimating radionuclide release to the environment (source terms) as a result of an accident at a nuclear power reactor are discussed. The major factors affecting potential radionuclide releases off site (source terms) as a result of nuclear power plant accidents are described. The quantification of these factors based on plant instrumentation also is discussed. A range of accident conditions from those within the design basis to the most severe accidents possible are included in the text. A method of gross estimation of accident source terms and their consequences off site is presented. 39 refs., 48 figs., 19 tabs.

658 **(NUREG/CP—0096) Transactions of the sixteenth water reactor safety information meeting.** Weiss, A.J. (comp.). (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Oct 1988. 281p. (CONF-8810155—Summs.). NTIS, PC A13/MF A01 - GPO. Order Number TI89001178/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

This report contains summaries of papers on reactor safety research to be presented at the 16th Water Reactor Safety Information Meeting at the National Bureau of Standards in Gaithersburg, Maryland, October 24--27, 1988. The summaries briefly describe the programs and results of nuclear safety research sponsored by the Office of Nuclear Regulatory Research, USNRC. Summaries of invited papers concerning nuclear safety issues are also included from the Office of Nuclear Reactor Regulation and Nuclear Material Safety and Safeguards, USNRC, in addition to summaries of invited papers that cover the high-lights of reactor safety research conducted by the Department of Energy (DOE), the electric utilities, through the Electric Power Research Institute (EPRI), the nuclear industry, and the research of government and industry in Europe and Japan. The summaries have been compiled in one report to provide a basis for meaningful discussion and information exchange during the course of the meeting, and are given in the order of their presentation in each session.

659 **(NUREG/CR—5214) Analyses of natural circulation during a Surry station blackout using SCDAP/RELAP5.** Bayless, P.D. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1988. Contract AC07-76ID01570. 160p. (EGG—2547). NTIS, PC A08/MF A01 - GPO. Order Number TI89001654/JAW.

The effects of reactor coolant system natural circulation on the response of the Surry nuclear power plant during a station blackout transient were investigated. A TMLB' sequence (loss of all ac power, immediate loss of auxillary feedwater) was simulated from transient initiation until after fuel rod relocation had begun. Integral analyses of the system thermal-hydraulics and the core damage behavior were performed using the SCDAP/RELAP5 computer code and several different models of the plant. Three scoping calculations were performed in which the complexity of the plant model was progressively increased to determine the overall effects of in-vessel and hot leg natural circulation flows on the plant response. The natural circulation flows extended the transient, slowing the core heatup and delaying core damage by transferring energy from the core to structures in the upper plenum and coolant loops. Increased temperatures in the ex-core structures indicated that they may fail, however. Nine sensitivity calculations were then performed to investigate the effects of modeling uncertainties on the multidimensional natural circulation flows and the system response. Creep rupture failure of the pressurizer surge line was pre-

dicted to occur in eight of the calculations, with the hot leg failing in the ninth. The failure time was fairly insensitive to the parameters varied. The failures occurred near the time that fuel rod relocation began, well before failure of the reactor vessel would be expected. A calculation was also performed in which creep rupture failure of the surge line was modeled. The subsequent blowdown led to rapid accumulator injection and quenching of the entire core. 18 refs., 105 figs., 17 tabs.

660 **(ORNL/EIS—154/V9) Nuclear facility decommissioning and site remedial actions: A selected bibliography, volume 9.** Owen, P.T.; Knox, N.P.; Michelson, D.C.; Turmer, G.S. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 423p. NTIS, PC A18. Order Number DE89001962/JAW.

The 604 abstracted references on nuclear facility decommissioning, uranium mill tailings management, and site remedial actions constitute the ninth in a series of reports prepared annually for the US Department of Energy's Remedial Action Programs. Foreign and domestic literature of all types--technical reports, progress reports, journal articles, symposia proceedings, theses, books, patents, legislation, and research project descriptions--has been included. The bibliography contains scientific, technical, economic, regulatory, and legal information pertinent to the US Department of Energy's remedial action programs. Major sections are (1) Surplus Facilities Management Program, (2) Nuclear Facilities Decommissioning, (3) Formerly Utilized Sites Remedial Action Program, (4) Facilities Contaminated with Naturally Occurring Radionuclides, (5) Uranium Mill Tailings Remedial Action Program, (6) Uranium Mill Tailings Management, (7) Technical Measurements Center, and (8) General Remedial Action Program Studies. Subsections for sections 1, 2, 5, and 6 include: Design, Planning, and Regulations; Environmental Studies and Site Surveys; Health, Safety, and Biomedical Studies; Decontamination Studies; Dismantlement and Demolition; Site Stabilization and Reclamation; Waste Disposal; Remedial Action Experience; and General Studies. Within these categories, references are arranged alphabetically by first author. Those references having no individual author are listed by corporate affiliation or by publication description. Indexes are provided for author, corporate affiliation, title word, publication description, geographic location, and keywords. This report is a product of the Remedial Action Program Information Center (RAPIC), which selects and analyzes information on remedial actions and relevant radioactive waste management technologies. RAPIC staff and resources are available to meet a variety of information needs. Contact the center at (615) 576-0568 or FTS 626-0568.

661 **(SAND—88-0581) Results and phenomena observed from the DF-4 BWR [boiling water reactor] control blade-channel box test.** Gauntt, R.O.; Gasser, R.D.; Fryer, C.P.; Walker, J.V. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-881014—13). NTIS, PC A02/MF A01. Order Number DE89001377/JAW.

From International European Nuclear Society/American Nuclear Society meeting on thermal reactor safety; Avignon, France (2 Oct 1988).

The DF-4 in-pile fuel damage experiment, one of a series of tests performed as part of the USNRC's internationally sponsored severe fuel damage (SFD) program, and carried out at Sandia National Laboratories, addressed the behavior of boiling water reactor (BWR) fuel canisters and control blades in the high temperature environment of an unrecovered loss of coolant accident. The DF-4 test is described in some detail herein and results from the experiment are presented. Significant results from prior experiments in the series are also summarized. Important findings from the DF-4 test include the low temperature melting of the stainless steel control blade caused by reaction with the B_4C, and the subsequent low temperature attack of the Zr-4 channel box by the relocating molten blade components. This early melt and relocation phenomena could significantly influence the progression of meltdown in BWRs and should be considered in SFD accident analyses. 14 refs., 9 figs.

662 **(SAND—88-2942C) NRC research in common-cause failures.** Mitchell, D.B.; Parry, G.W.; Paula, H.M.; Whitehead, D.W.; Rasmuson, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-8810155—3). NTIS, PC A03/MF A01. Order Number DE89001823/JAW.

From 16. water reactor safety information meeting; Gaithersburg, MD, USA (24 Oct 1988).

The status and recent history of common-cause failure (CCF) research are briefly reviewed. Current NRC research in the area of CCFs is described with emphasis on the remaining problem areas. These include deficiencies in data and the need to more completely understand the characteristics of CCFs. The concepts and relationships of root cause, coupling mechanisms, and defensive mechanisms are discussed. Key definitions and some in-depth analysis of these concepts are included. An overview of the recent research to be published is presented. This research includes: (1) the cause-defense methodology for analyzing CCFs; (2) guidelines for identifying potential CCFs as part of a nuclear power plant walkdown and procedures review; and (3) requirements for an industry-wide data base, including documentation of failure events and additional component failure and failure mode data requirements to support future PRAs. 5 refs.

663 **(SSI—87-25) Decommissioning policy in Sweden.** Bergman, C.; Boge, R.; Snihs, J.O. (National Inst. of Radiation Protection, Stockholm (Sweden)). 26 Aug 1987. 17p. (CONF-871018—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755275/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

In Sweden the nuclear power program is, according to a parliamentary decision, limited to twelve power producing reactors. The last reactor shall be taken out of service no later than the year 2010. As a result of the Chernobyl accident the program for taking the reactors out of service will be accelerated. This report is the first approach by the Swedish authorities to formulate a decommissioning policy. It is not the final policy document but it discusses the principal questions from the special Swedish viewpoint.

664 **(WHC-SA—0403) State-of-the-art incore detector system provides operational and safety benefits: Example, Hanford N Reactor.** Toffer, H. (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1988. Contract AC06-87RL10930. 24p. (CONF-8808109—4). NTIS, PC A03/MF A01. Order Number DE89002118/JAW.

From DOE/ANL training course on the potential safety impact of new and emerging technologies on the operation of DOE nuclear facilities; Idaho Falls, ID, USA (29 Aug 1988).

A presentation on the operational and safety benefits that can be derived from a state-of-the-art incore neutron monitoring system has been prepared for the DOE/ANL training course on "The Potential Safety Impact of New and Emerging Technologies on the Operation of DOE Nuclear Facilities." Advanced incore neutron flux monitoring systems have been installed in some commercial reactors and should be considered for any new reactor designs or as backfits to existing plants. The recent installation of such a system at the Hanford N Reactor is used as an example in this presentation. Unfortunately, N Reactor has been placed in a cold standby condition and the full core incore system has not been tested under power conditions. Nevertheless, the evaluations that preceded the installation of the full core system provide interesting insight into the operational and safety benefits that could be expected.

665 **Method and apparatus for diagnosing breached fuel elements.** Gross, K.C.; Lambert, J.D.B.; Nomura, S. (to Dept. of Energy, Washington, DC). US Patent 4,764,335. 16 Aug 1988. Filed date 2 Mar 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a nuclear reactor having a core of fuel elements, the elements having a cladding, and the reactor having a cover gas and a cover-gas clean up system for removing fission gas activity from the cover-gas the cover-gas clean up system comprising an argon gas purging system, an on-line breached fuel element diagnostic system is described comprising: (a) a detector means responsive to

fission gas isotope activity in the cover-gas; (b) means for measuring the argon purge rate of the argon gas purging system; (c) processing means responsive to the outputs of the detector and the argon purge rate measuring means and operable to calculate the corrected gas activity.

666 **Inherent shutdown capabilities of metal-fueled liquid-metal-cooled reactors during unscrammed loss-of-flow and loss-of-heat-sink incidents.** Ott, K.O. (Purdue Univ., School of Nuclear Engineering, West Lafayette, IN (US)). *Nuclear Science and Engineering:* **99**: No. 1, 13-27(May 1988).

The longer term response of oxide- and metal-fueled liquid-metal-cooled reactors to unscrammed loss-of-flow and loss-of-heat-sink failures is investigated. The investigation consists of a review of numerical transient calculations performed by the Argonne National Laboratory Reactor Analysis and Safeety Division, and of analytical analyses of semiasymptotic states. The emphasis is on the identification and evaluation of an inherent shutdown state for metal fuel, with its high heat conductivity, as an alternate to the familiar low-power asymptotic critical state. Design implications for retaining the inherently effected shutdown for a sufficiently long period are discussed and quantitatively evaluated. In addition, the effect of uncertainties of reactivity coefficients on predictions for such unscrammed transients is investigated. It is shown how measurements during a preoperational safety demonstration phase can validate and possibly correct those predictions.

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 383

2504 Capacitor Banks

REFER ALSO TO CITATION(S) 1533

2506 Thermal

REFER ALSO TO CITATION(S) 849

667 **(BFR-R—64-1987) Heat storage in insulated rock ditch or cavity.** Hultmark, G.; Olson, S.; Flodihn, B.; Gass, R.; Gustafson, G.; Edin, K.; Dalenbaeck, J.O. (AB Andersson et Hultmark, Goeteborg (SE); Viak AB, Goeteborg (SE); Chalmers Tekniska Hoegskola, Goeteborg (SE). Inst. f. Installationsteknik). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755027/JAW.

In order to reduce costs for heat storage of up to 50000 cubic metres of size a new storing concept has been developed. It consists of a pit in the ground with profile blasted walls insulated with polyurethane foam sprayed direct on the walls. The insulation is covered with a sealing layer in order to prevent water from the store to diffuse into the insulation. In this specific project a smaller space of 27 cubic metres has been built in order to gain information from insulation of rock walls with polyurethane foam and how to use elastomers as sealing layer. Measurements at 90 degrees C during the operation phase and foam samples from the post operation phase show that polyurethane based elastomers is not suitable as sealing layer against water at 90 degrees C. Direct application of foamed polyurethane elastomers sticks on well to a dry rock surface if primer is used. The density of the insulation must be continuously controlled during the spraying in order to obtain good quality of the insulation. Drain of ground water and tightening at ground level against rainwater is necessary to keep the insulation dry towards the rock surface. A rough calculation over moisture content and electric energy supplied shows that the thermal conductivity has increased by a factor of 5. (L.F.).

668 **(BFR-R—80-1987) Heat storage in boreholes in Luleaa. Thermal evaluation.** Dimle, P.; Wilhelmsson, M. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 38p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755031/JAW.

During the last 3 years a heat storage in rocks has been operating at the premises of the Luleaa institute of technology. The purpose of the project has been to test this kind of energy storage in 1/10 of full scale. Apart from the rock storage, the plant consists of a heat pump installation and a control system which controls various operational cases of storage discharge. The technical arrangements have been working well. Savings due to the rock storage are calculated to about SEK 150 000/year. The plant has not contributed to the desired degree of yield mainly due to the fact that the storage was not loaded to full capacity. (L.F.).

669 **(BFR-R—82-1987) Satellite heat storage. Local heat storage of a district heating system. A case study.** Hofgren, K.H.; Buresten, R.; Johnson, G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 30p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755032/JAW.

The load variations in a district heated network can be suppressed by installing a heat storage at the consumer's premises. In this study technical and economical analysis are made concerning the possibilities to store in clay layers waste heat surplus from a district network which has been produced during summertime. The emphasis is put on the short term margin costs for the heat production and the rate fee. It has been stated that it gives a certain profit for the heat producer and the consumer's total energy cost will be about SEK 310/MWh which compared with other possible alternatives is a low level of cost. Compared with conventional connections to district heating networks there is an economical breaking point for a crude oil price of USD 24-25/barrel. (L.F.).

670 **(BFR-R—84-1987) Scandonavian collaboration for heat storage in excavated pit heat stores.** Lundin, E.S.; Widing, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 155p. (In Swedish). (CONF-8705340—). NTIS (US Sales Only), PC A08. Order Number DE88755033/JAW.

From NBS-E seminarium; Vaexsjoe, Sweden (12 May 1987).

The objective of this Nordic seminar day was to present a wide-ranging status report of the state of development of methods of storing hot water in excavated pit heat stores. Key aspects such as store applications, sealing materials, insulation, stability of excavations and cost were considered in detail. Insulated stores of this type, used as seasonal heat stores, are needed for medium-scale application of solar heating (group heating plants). Used in conventional heating systems, the stores can serve as short-term heat stores to even out power and energy demand peaks. The method works, but constructional methods and materials need to be further developed and systems simplified. Specific costs now are in the range SEK 400-800 per m/sup 3/. This cost needs to be halved for successful aplication as seasonal heat stores, but short-term heat stores can be economically viable with constructional costs in the range of SEK 500-1500 per m/sup 3/. Most of any cost reductions are probably to be found in connection with sealing and insulation, which together account for about 50% of the total cost. The most suitable sealing materials at present appear to be PEM and EPDM sheets, with life expectancies of at least 25 years when operated at a temperature of +80 degree C. Designs using what are known as metal liners, separation layers and clay should be tested. The stability of deep excavations in earth can be ensured by using the lime pillar method or JET curtain walls/pillars of concrete. The general feeling was that fullscale projects, carried out in parallel with further research into materials, would best serve the interests of development. (authors).

671 **(LIU-TEK-LIC—1986-06) Short time heat stores for heating of industrial buildings.** Johansson, T. (Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering). Feb 1986. 152p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755046/JAW.

The aim of this work has been to elucidate if surplus heat produced at productive time at companies with intermittent periodic duty can be stored and used for space heating. The energy storage potential of process heat for comfort ventilation has also been studied. The energy storage potential of process heat for comfort ventilation have been elucidated. Detailed data concerning process dynamics have been collected, and a full scale test of heat storage for space heating has been performed in a bakery. The conclusions drawn in this thesis are that - there are big energy flows with in the industry today that not utilized. Very good possibilities exists for preservation of surplus energy by energy storage. - Surplus energy can be utilized for comfort thermal processes. (BoK). With 61 refs.

672 **(LIU-TEK-LIC—1986-34) Latent heat storage - simulation and experiment.** Solmar, A. (Linkoeping Univ. (Sweden). Dept. of Mechanical Engineering). 15 Jan 1987. 76p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755047/JAW.

An experiment rig has been constructed, where different types of phase-change material can be placed in an air flow. The temperature of the air can be varied between 10 and 90 degrees C, and the air flow can vary between 1500 and 15000 m/sup 3//hour. The air humidity can also be varied. Measurement and control is performed through a computer. A numerical simulation model is suggested for construction and analysis of latent heat stores. Simulations and experiments have been performed. Results can be expressed as a heat transfer coefficient between the fluid and the phase-change material. A method for validation of the simulation model is suggested. (With 33 refs.) (L.E.).

673 **(PB—88-868823/XAB) Thermal energy storage. May 1983-June 1987 (Citations from the NTIS data base). Report for May 1983-June 1987.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 189p. NTIS PC N01/MF N01.

This bibliography contains citations concerning thermal energy storage in reservoirs, aquifers, rock beds, molten salts, and manufactured storage devices, such as Trombe walls and direct-gain cells. The citations cover the design, evaluation, theory, and materials used. Some citations report on effects of using certain storage media, such as aquifers. (This updated bibliography contains 399 citations, none of which are new entries to the previous edition.)

674 **(PB—88-868831/XAB) Thermal energy storage. July 1987-September 1988 (Citations from the NTIS data base). Report for July 1987-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 91p. NTIS PC N01/MF N01.

Supersedes PB—87-864286.

This bibliography contains citations concerning thermal energy storage in reservoirs, aquifers, rock beds, molten salts, and manufactured storage devices, such as Trombe walls, direct-gain cells, and phase change materials for solar heating and spacecraft. The citations cover the design, evaluation, theory, and materials used. Some citations report on effects of using certain storage media, such as aquifers. (This updated bibliography contains 129 citations, all of which are new entries to the previous edition.)

675 **(PNL-SA—15909) Energy and environmental issues of aquifer thermal energy storage.** Kannberg, L.D. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 8p. (CONF-881033—2). NTIS, PC A02/MF A01. Order Number DE89001999/JAW.

From International congress on technology and technology exchange; Pittsburgh, PA, USA (18 Oct 1988).

Aquifer thermal energy storage (ATES) has the potential to provide storage for large-scale industrial and building heating and cooling at many sites in the US. However, implementation requires careful attention to site geohydraulic and geochemical characteristics. Field tests in the US have shown that over 60% of the heat injected at temperatures over 100{degree}C can be recovered on a seasonal cycle. Similarly, aquifer storage of chilled groundwater can provide building cooling with a reduction of over 50% in annual cooling electrical energy consumption and a factor of 20 reduction in summer cooling peak electrical demand. Heat ATES will require water treatment at most sites to prevent precipitation of calcium and magnesium carbonates and silica (depending upon the temperature regime). Environmental concerns create a need for detailed geochemical and water treatment analysis using models and laboratory studies. At some sites microbiological issues must also be resolved. In some instances bacteria can cause extensive corrosion or clogging of the well screen and surrounding porous media. At other sites effects on indigenous beneficial microbiota and the potential for augmenting growth and release of pathogenic organisms are of concern. Laboratory research as well as field testing is being conducted to extend and augment experience in related technologies. Results from field testing and environmental monitoring have not revealed dramatic environmental impacts. Rather, they have revealed the strong potential for geochemical and geohydraulic factors to influence successful ATES operations. 12 refs., 3 figs., 2 tabs.

2509 Batteries

REFER ALSO TO CITATION(S) 863, 1065

676 **(AD-A—195821/4/XAB) Morphological changes in polymer electrolyte cells. Technical report 15 Jul 85-30 May 88.** Munshi, M.Z.; Owens, B.B. (Minnesota Univ., Minneapolis (USA). Corrosion Research Center). May 1988. 24p. NTIS, PC A03/MF A01.

Rechargeable solid-state batteries utilizing lithium anodes, V_6O_{13} composite cathodes and polymer electrolytes made from polyethylene oxide - $LiCF_3SO_3$ complex were investigated at 100 C. The cells exhibited good cycling and reversibility. Optical and scanning electron microscopy were used, the morphological changes taking place at the electrodes and electrolyte as a function of cycle number. Post-mortem examination of the cell material indicated that the structures of lithium, electrolyte, and cathode become finer-grained and hence smoother. In addition, the structures were more coherent. The cathode appeared to undergo a rehealing process during the early stage of cycling. The results indicate that the structures are consistent with one another and that long cycle life can be obtained with these types of cells.

677 **(CONF-881162—2) Opportunities for optimizing EV battery performance, battery specific power, and vehicle equivalent electrical circuit considerations.** Spindler, W.C.; Driggans, R.L.; Christianson, C.C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01. Order Number DE89000609/JAW.

From 9. electric vehicle symposium; Toronto, Canada (13 Nov 1988).

This paper addresses the possibilities for improving the interfaces between the battery, drive train, and charger in the design of EVs for commercial fleet uses. It shows that the optimum power condition may occur at about 75% of the open circuit voltage rather than the maximum power point of about 50% of the open circuit voltage. This paper proposes a need to determine the specifications for battery specific power (W/kg) by taking into account the loss characteristics of the motor and final drive in addition to the battery loss characteristics. 5 refs., 4 figs., 1 tab.

678 **(LBL—25506) Technology base research project for electrochemical energy storage: Executive summary report for 1987.** Kinoshita, K. (ed.). (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016121/JAW.

The US Department of Energy's Office of Energy Storage and Distribution provides continuing support for an Energy Storage Program, which includes R&D on advanced electrochemical energy storage and conversion systems. A major goal of this program is to develop electrochemical power sources suitable for application in electric vehicles and/or electric load-leveling devices. The program centers on advanced secondary batteries and fuel cells that offer the potential for high performance and low life-cycle costs, both of which are necessary to permit significant penetration into commercial markets.

679 **(N—88-24206) Aerospace energy systems laboratory: Requirements and design approach.** Glover, R.D. (National Aeronautics and Space Administration, Edwards AFB, CA (USA). Dryden Flight Research Center). May 1988. 12p. (NASA-TM—100423; H—1448; NAS—1.15:100423; CONF-8805208—). NTIS, PC A03/MF A01.

From ISA aerospace industries/test measurement symposium; Albuquerque, NM, USA (2 May 1988).

The NASA Ames-Dryden Flight Research Facility at Edwards, California, operates a mixed fleet of research aircraft employing nickel-cadmium (NiCd) batteries in a variety of flight-critical applications. Dryden's Battery Systems Laboratory (BSL), a computerized facility for battery maintenance servicing, has developed over two decades into one of the most advanced facilities of its kind in the world. Recently a major BSL upgrade was initiated with the goal of modernization to provide flexibility in meeting the needs of future advanced projects. The new facility will be called the Aerospace Energy Systems Laboratory (AESL) and will employ distributed processing linked to a centralized data base. AESL will be both a multistation servicing facility and a research laboratory for the advancement of energy storage system maintenance techniques. This paper describes the baseline requirements for the AESL and the design approach being taken for its mechanization.

680 **(N—88-25059) Small scale bipolar nickel-hydrogen testing.** Manzo, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 10p. (NASA-TM—100936; E—4216; NAS—1.15:100936; CONF-880665—). NTIS, PC A02/MF A01.

From 33. international power source symposium; Cherry Hill, NJ, USA (13 Jun 1988).

Bipolar nickel-hydrogen batteries, ranging in capacity from 6 to 40 A-hr, have been tested at the NASA Lewis Research Center over the past six years. Small scale tests of 1 A-hr nickel-hydrogen stacks have been initiated as a means of screening design and component variations for bipolar nickel-hydrogen cells and batteries. Four small-scale batteries have been built and tested. Characterization and limited cycle testing were performed to establish the validity of test results in the scaled down hardware. The results show characterization test results to be valid. LEO test results in the small scale hardware have limited value.

681 **(N—88-25978) Effect of LEO cycling at shallow depths of discharge on MANTECH IPV nickel-hydrogen cells.** Smithrick, J.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 9p. (NASA-TM—101300; E—4122; NAS—1.15:101300; CONF-880702—). NTIS, PC A02/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

An individual pressure vessel nickel-hydrogen battery is being considered as an alternate for a nickel-cadmium battery on the Hubble Space Telescope. The space telescope battery will primarily be operating at a shallow depth of discharge (10 percent DOD) with an occasional 40 percent DOD. This shallow DOD raises several issues: (1) What is the cycle life. It is projected to be acceptable; however, there is no reported real time data base for validation. (2) The state of charge of the nickel electrode at the beginning of charge is 90 percent. Will this cause an acceleration of divergence in the battery individual cell voltages. (3) After prolonged cycling at 10 percent DOD, will there be enough capacity remaining to support the 40 percent DOD. (4) Is the state of charge really 90 percent during cycling. There is no reported real time data base at shallow depths of discharge. A data base to address the above issues was initiated.

682 **(N—88-26430) Performance of lightweight nickel electrodes.** Britton, D.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 8p. (NASA-TM—100958; E—4252; NAS—1.15:100958; CONF-880665—). NTIS, PC A02/MF A01.

From 33. international power source symposium; Cherry Hill, NJ, USA (13 Jun 1988).

The NASA Lewis Research Center is currently developing nickel electrodes for nickel-hydrogen (Ni-H2) batteries. These electrodes are lighter in weight and have higher energy densities than the heavier state-of-the-art (SOA) sintered nickel electrodes. In the present approach, lightweight materials or plaques are used as conductive supports for the nickel hydroxide active material. These plaques (fiber and felt, nickel plated plastic and graphite) are commercial products that are fabricated into nickel electrodes by electrochemically impregnating them with active material. Evaluation is performed in half cells structured in the bipolar configuration. Initial performance tests include capacity measurements at five discharge levels, C/2, 1.0C 1.37C, 2.0C and 2.74C. The electrodes that pass the initial tests are life cycle tested in a low Earth orbit regime at 80 percent depth of discharge. Different formulations of nickel fiber materials obtained from several manufacturers are currently being tested as possible candidates for nickel electrodes. One particular lightweight fiber mat electrode has accumulated over 3000 cycles to date, with stable capacity and voltage. Life and performance data of this electrode were investigated and presented. Good dimensional stability and active material adherence have been demonstrated in electrodes made from this lightweight plaque.

683 **(PB—88-235924/XAB) Long-cycle-life solid-state solid-polymer electrolyte cells. Final report. Report on Phase 1.** Sammells, A.F.; Semkow, K.W.; Cook, R.L. (Eltron Research, Inc., Aurora, IL (USA)). Jul 1986. 67p. NTIS, PC A04/MF A01.

Experimental work was directed toward determining the viability of two complementary solid-state electrochemical cells incorporating Na^+ and Li^+ conducting solid polymer electrolytes (SPE). SPEs used included those based upon poly(ethylene oxide), poly(ethylene oxide)/poly(ethylene glycol) mixtures, and polyphosphazenes. For Li^+ conducting SPEs, $LixWO_2$ was used for the negative and TiS_2 for the positive electrode. In cells utilizing Na+ conducting SPEs, homogeneous matrix electrodes based upon transition-metal-doped B′-alumina were used for the positive and negative electrodes. Here transition metals were incorporated into immobile $A1^{3+}$ lattice sites within the B′-alumina structure, where changed in electrochemical potential upon cell charge/discharge cycling occurred via redox electrochemistry involving the doped immobile transition-metal species. Secondary cells were found to have respective open-circuit potentials of 2.2 and 1.5V, high electrochemical reversibility, and theoretical energy densities of 175 and 178 Wh/kg.

684 **(PB—88-867262/XAB) Lithium batteries. November 1981-July 1988 (Citations from the NTIS data base). Report for November 1981-July 1988.** (National Technical Information Service, Springfield, VA (USA)). Aug 1988. 177p. NTIS PC N01/MF N01.

Supersedes PB—87-866356.

This bibliography contains citations concerning design, development, components, testing, electrolytes, and safety aspects of lithium cells. Applications include use in electric vehicles, and utility load leveling operations. Lithium chloride and lithium-sulfur batteries are among the types discussed. (This updated bibliography contains 292 citations, 10 of which are new entries to the previous edition.)

685 **(PB—88-868492/XAB) Electrochemical reactions at surfaces. June 1985-August 1988 (Citations from the NTIS data base). Report for June 1985-August 1988.** (National Technical Information Service, Springfield, VA (USA)). Aug 1988. 127p. NTIS PC N01/MF N01.

Supersedes PB—87-857199.

This bibliography contains citations concerning electrode processes, mostly in aqueous solutions, but also involving some nonaqueous electrolytes. Included are those reactions associated with battery electrodes, fuel cells, and catalyst reactions, with some molten-salt processes. The reports cover electrochemical corrosion studies, chemisorption, theoretical analysis of surface reactions, electrical double layer, measurement techniques, and some applications of the electrode processes. (This updated bibliography contains 185 citations, 100 of which are new entries to the previous edition.)

686 **(PB—88-869128/XAB) Lithium batteries. October 1984-September 1987 (Citations from the Compendex data base). Report for October 1984-September 1987.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 154p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the design, development, and applications of lithium batteries. Topics include electrochemical aspects, cycling characteristics, performance evaluations, and applications in cardiac pacemaker devices. Batteries utilizing organic compounds, chlorides, and metal sulfides are discussed. (This updated bibliography contains 343 citations, none of which are new entries to the previous edition.)

687 **(PB—88-869136/XAB) Lithium batteries. October 1987-September 1988 (Citations from the Compendex data base). Report for October 1987-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 84p. NTIS PC N01/MF N01.

Supersedes PB—87-867560.

This bibliography contains citations concerning the design, development, and applications of lithium batteries. Topics include electrochemical aspects, cycling characteristics, performance evaluations, and applications in cardiac pacemaker devices. Batteries utilizing organic compounds, chlorides, and metal sulfides are discussed. (This updated bibliography contains 140 citations, all of which are new entries to the previous edition.)

688 **(RISO-M—2703) Batteries for energy storage in wind/diesel systems.** Katic, I. (Risoe National Lab., Roskilde (Denmark)). Aug 1988. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755064/JAW.

The advantages of storing energy in local electrical supply systems, based on wind power and diesel fuel, are obvious. Surplus wind energy can be stored for later use, and thus minimize the runtime for the diesel generator. The diesel engine can be operated at a high load when running, giving maximum efficiency of the system. Electrochemical energy storage systems are available from industry in a number of varieties. Two of the most widely used, the Lead-acid and the Nickel/Cadmium alkaline batteries are treated in this report, and their application in wind/diesel systems are assessed.

689 **Lithium disulfide battery.** Kaun, T.D. (to Dept. of Energy, Washington, DC). US Patent 4,764,437. 16 Aug 1988. Filed date 29 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A secondary electrochemical cell having an FeS/sub 2/ positive electrode having about 15 mole percent CoS/sub 2/, a Li alloy negative electrode and a suitable lithium-containing electrolyte, the cell being negative electrode limited and having only an endothermic discharge reaction of the positive electrode, wherein the cell operating temperatures are in the range of from about 340° to about 400°C, the electrolyte is about 25 mole percent LiCl and about 38 mole percent LiBr and about 37 mole percent KBr, the negative electrode has Li present in the range of from about 48 atom percent to about 53 atom percent.

690 **Solid state tetrachloroaluminate storage battery having a transition metal chloride cathode.** Vaughn, R.L.; Carpio, R.A.; King, L.A. (to Secretary of the Air Force, Washington, DC). US Patent 4,764,438. 16 Aug 1988. Filed date 5 Jun 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method is described for producing a low power, high energy source of electric current which comprises the steps of: A. providing a solid state electrochemical primary cell containing as essential components: (a) a solid anode composed of an alloy selected from the group consisting of lithium-silicon and lithium-aluminum alloys, (b) a solid cathode of a mixture having a ratio of (1) from about one to five parts by weight of ferric chloride and (2) about one part by weight of graphite, and (c) a solid electrolyte consisting of lithium tetrachloroaluminate salt, the electrolyte positioned between, and, in contact with the anode and the cathode; and B. heating the electrochemical cell to a temperature in a range of from 85°C to about 105°C to draw an electric current therefrom while simultaneously maintaining the electrochemical cell in its solid state at a temperature below the melting points of its individual components.

691 **Transference number calculations for sodium polysulfides.** Risch, T.; Newman, J. (Acurex Corp., Aerotherm Div., Mountain View, CA (US)). *Journal of the Electrochemical Society;* **135**: No. 7, 1715-1729(Jul 1988).

Transference numbers of sodium cations and sulfur anions in sodium polysulfide melts are calculated from previously determined experimental data. Concentrated electrolyte theory assuming a binary electrolyte consisting of sodium anions, sulfide cations, in a neutral sulfur solvent is used to relate the transference numbers to fundamental solution transport properties. Slopes of open-circuit potential measurements vs. melt composition on sodium-sulfur cells with and without transference are used to determine the sulfur anion and sodium cation transference numbers. The transference number of sodium cations is calculated from previous experimental data for two temperatures, 573 and 633 K, and range from 0.88 to 0.93 for sodium sulfide mole fractions between 0.20 and 0.34. These values for transference numbers presented here are more accurate than previous interpretations of these data where unity sodium cation transference numbers were assumed. The results of this work are shown to be important in the design of sodium-sulfur cells.

692 **An AC impedance study of the degradation of porous nickel battery electrodes.** Lenhart, S.J.; Macdonald, D.D.; Pound, B.G. (Ford Aerospace Corp., Palo Alto, CA (US)). *Journal of the Electrochemical Society;* **135**: No. 5, 1063-1070(May 1988).

AC impedance spectra of porous nickel battery electrodes were recorded periodically during charge/discharge cycling in concentrated KOH solution at various temperatures. A transmission line model (TLM) was adopted to represent the impedance of the porous electrodes, and various model parameters were adjusted in a curve fitting routine to reproduce the experimental impedances. Degradation processes were deduced from changes in model parameters with electrode cycling time. In developing the TLM, impedance spectra of planar (nonporous) electrodes were used to represent the pore wall and backing plate interfacial impedances. These data were measured over a range of potentials and temperatures, and an equivalent circuit model was adopted to represent the planar electrode data. Cyclic voltammetry was used to study the characteristics of the oxygen evolution reaction on planar nickel electrodes during charging, since oxygen evolution can affect battery electrode charging efficiency and ultimately electrode cycle life if the overpotential for oxygen evolution is sufficiently low. Transmission line modeling results suggest that porous rolled and bonded nickel electrodes undergo restructuring during charge/discharge cycling prior to failure. The average pore length and the number of active pores decreases during cycling, while the average solid phase resistivity increases. The average solution phase resistivity remains relatively constant during cycling, and the total porous electrode impedance is relatively insensitive to the solution/backing plate interfacial impedance.

29 ENERGY PLANNING AND POLICY

693 **(INIS-mf—11815) Report on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.** Ederer, F.; Schulz, W.; Steinkamm, A. (eds.). (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Volkswirtschaftslehre). 1987. 581p. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

This research project was carried through before Chernobyl, in a time where things were normal. Thus it is concerned with determining basic notions and relationships of the energy industry, with problems related to the national economy and to law in individual sectors of energy supply. Possible and useful alternatives are presented and are verified as to their feasibility. The lines of argument are as follows: Line-transmitted energy sources electricity and gas - basic considerations - power plants - environmental protection - energy concepts; Legal problems - licensing procedure - procedural law; Questions relating to the national economy - energy

forecasts - prices - substitution; Energy conservation; Alternative energy technologies. (HSCH).

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 749, 815

694 **(FRCEA-TH—101-T-1) Economic growth and energy consumption.** Devezeaux de Lavergne, J.G. (Paris-1 Univ., 75 (France)). Dec 1986. 342p. (In French). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88755301/JAW.

The objective of this study was to evaluate the interrelation between the energy price successive rises in the '70 s and the french economy growth rate decline in the same period and to develop an operational tool for the economical policy prevision and analysis: a mathematical model (MELODIE) has been used. It appears that the relation between energy consumption level and the gross national product level is very tight.

695 **(Juel-Spez—421) International Energy Agency: Energy Technology Systems Analysis Project (IEA - ETSAP). Final report on annex II, July 1983 - June 1986.** Kolb, G. (ed.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung). Nov 1987. 268p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88755237/JAW.

The objective of Annex II (Juli 1983 - June 1986) was to carry out a continuous exchange of information related to energy modelling, energy systems analysis and energy technology assessment in order to share experience, stimulate co-operative studies and benefit from common analysis. The means were: Exchange of reports, memoranda etc., periodic workshops or seminars, maintenance of the MARKAL model including consultative service of the Operating Agent, preparation and distribution of a periodical newsletter and meetings for establishing new tasks.

696 **(ORNL/TM—10727) Gas furnace purchases: A study of consumer decision making and conservation investments.** Cantor, R.A.; Trumble, D.A. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 131p. NTIS, PC A07/MF A01. Order Number DE89001333/JAW.

This study assists the DOE Office of Business and Community Systems (OBCS) by unraveling some of the issues involved in the consumer- choice problem in the particular case of replacement gas furnaces. It is likely that many market-failure reasons and major insights from several theoretical frameworks are relevant to the replacement gas furnace problem. However, little is known about the overall implications. Which factors are most important and to what extent policy actions can alter the investment decisions remain largely unanswered questions. Additionally, there is little basis for discriminating among the factors to suggest efficient policy actions. The objective of this report is to address these concerns by studying a national survey of consumers who recently purchased a gas furnace. The focus is on the decision-making process of consumers and the analysis concentrates on testing some hypotheses suggested by the literature and past policy actions. The survey resulted in 639 usable responses for the general analysis. Three methods of analysis are applied to the survey data: statistical analysis of survey responses about the actual purchase; analysis of hypothetical-choice problems that were part of the survey; and simulation analysis to compare actual choices with those selected by a cost-minimizing model. 14 refs., 3 figs., 32 tabs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 80, 694, 704, 731, 745

697 **(BFR-R—35-1987) 'Performance purchasing' of low-energy solutions for a swimming bath.** Dahlquist, S.G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 28p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755020/JAW.

This report describes practical application of a new way of purchasing low-energy system applications, known as 'Performance purchasing'. It has been applied in connection with the rebuilding of the Motala swimming baths and sports complex during 1984. Performance purchasing involves an expanded from of turnkey contract, with a greater element of risk for the main contractor through the energy consumption guarantees required from him, based on specifications and requirements in the purchasing specification. The objective of performance purchasing is to achieve the greatest possible profitability for the purchase/user, based on performance requirements specified by him. This means that each tenderer may put forward whatever design he feels best meets the specified requirements, based on his own circumstances. Long-term measurements of heat (oil), electricity and water that have been made over a period of a year indicate full agreement between as-measured consumption and theoretical consumption based on the conditions specified in connection with purchasing. Before rebuilding, total specific annual consumption of heat and electricity amounted to 430 kWh/m/sup 2/ of floor area, reducing to 270 kWh/m/sup 2/ after rebuilding, i.e. a reduction of 48% of original consumption. Total investment cost amounted to SEK 4.4 million, equivalent to about SEK 370/m/sup 2/ of floor area.

698 (INIS-mf—11815, pp 355-373) **Regional energy planning - the energy supply concept of Munich.** Hoegner, W. (Stadt Muenchen (Germany, F.R.)). 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The following criteria are essential in the city of Munich's planning of energy: safeguarding secure and inexpensive provision of energy to consumers, achieving non-polluting and economical energy conversion, adopting a flexible policy aiming to maintain the competitivity of energy produced in the long term. Energy conversion will become more environmentally compatible if existing dual-purpose power plants are retrofitted with high-efficiency flue gas purification systems, if more renewable energy sources are used, and if power plants situated in the centre of cities are decommissioned. A well-balanced consumption of fuel minimizes risks associated with availability and pricing. (orig./HSCH).

699 (INIS-mf—11815, pp 466-486) **Pricing and price control in the energy industry.** Kramm, D. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The paper deals with the following problems: prices for energy in social free market economy - scarcity of the commodity 'energy' - sensitiveness towards energy prices; principles and elements of pricing for the different energy sources; preventive state control over prices - legal bases for fixing maximum prices; instruments provided by the antitrust laws to prevent price misuse - non-preventive price control in monopoly sectors - competitive critera adopted in price control. The paper states as follows: Control over monopolies cannot be dispensed with, but it is necessary to adopt competition-oriented criteria of evaluation. (orig./HSCH).

700 **(SOL—88-12) Analyzing the effects of technological change: A computable general equilibrium approach.** McAllister, P.H.; Stone, J.C.; Dantzig, G.B. (Stanford Univ., CA (USA). Systems Optimization Lab.). Sep 1988. Contract FG03-87ER25028. 62p. NTIS, PC A04/MF A01. Order Number DE89001970/JAW.

Analyzing the effects of technological changes occurring simultaneously in many sectors of the economy is most meaningfully approached via mathematical models constructed in a general equilibrium framework. In order to be suited to a study of technical change, an equilibrium model should be dynamic, have a long time

horizon, and allow production to be disaggregrated into a large number of sectors. The size of the resulting model, however, will place it beyond the capability of existing algorithms to solve, unless some special assumptions are made. We describe a class of so-called computable general equilibrium models which have been suitably restricted in order to allow efficient computational implementation. An important example of this class is the PILOT model of the US economy, which combines a process-oriented representation of production with a system of smooth consumer demand functions. Solutions of the PILOT model provide an internally consistent overall picture of the long-run consequences of technological change and of government policy and foreign market conditions in the context of technological change. We report the results of a study using PILOT to assess important differences between a "high-tech" and a "low- tech" economy, in terms of aggregrate and sectoral patterns of growth, employment, and energy use over the next 25 years. The scenario analysis presented effectively illustrates the analytical advantages of the general equilibrium perspective. By far the most interesting effects of changing patterns of availability for advanced technology turn out to be indirect effects mediated through shifts in comparative advantage in international trade and through income effects in personal consumption. The only rigorous way to capture such effects is through the use of a general equilibrium analysis. 16 refs., 25 figs., 1 tab.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 38, 214, 255, 660, 698, 717, 731, 738, 857, 864, 1688, 1699, 1700, 1711, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1720, 1721, 1728, 1734, 1735, 1736, 1760, 1761, 1762, 1763, 1764, 1775, 1776, 1777, 1790, 1792, 1794, 1796, 1797, 1798, 1799, 1802, 1823, 1827, 1828, 1829, 1830, 1831, 1832, 1833, 1834, 1835, 1836, 1837, 1838, 1839, 1840, 1841, 1844, 1845, 1887, 1888, 1909, 2417, 2418

701 **(AD-A—195563/2/XAB) Chemical warfare: a new national policy for America.** Nell, P.A. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA). School of Advanced Military Studies). 26 Apr 1988. 79p. NTIS, PC A05/MF A01.

In a broad sense, the use of chemicals in war dates back almost to the beginning of recorded military history. Fire, smoke, and battlefield obscurants were used quite effectively throughout the course of military operations. However, chemical weapons, as we think of them today, first appeared during World War I. After World War I and during the interwar period, the warring parties, recognizing the awesome potential of chemical weapons on the battlefield, initiated programs to develop and stockpile arsenals of these munitions for possible use during future conflicts. An objective analysis of the respective offensive and defensive chemical capabilities of the United States and the Soviet Union might suggest that this nation's 'non-first use' chemical weapons policy warrants re-evaluation, particularly when viewed at levels of conflict above the tactical.

702 **(AD-A—196162/2/XAB) Installation-Restoration Program. Phase 1. Records search. Buckley Air National Guard Base Aurora, Colorado.** (Simons, Li and Associates, Inc., Fort Collins, CO (USA)). 31 Aug 1982. 96p. NTIS, PC A05/MF A01.

Buckley ANGB is located in Aurora, Colorado. Buckley was activated in 1942 and has operated under Army, Navy, and Air National Guard command. The primary mission of the base is to train Air National Guard personnel. The Department of Defense(DoD) has developed a program to identify and evaluate past hazardous-material sites on DoD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation-Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/ Records Search; Phase II, Problem Confirmation; Phase III, Technology Base Development; and Phase IV, Operations. Hazardous materials; waste.

703 **(AD-A—196278/6/XAB) Installation-Restoration Program Records search for Des Moines Air National Guard Installation, Iowa.** (CH2M Hill, Gainesville, FL (USA)). Sep 1983. 121p. NTIS, PC A06/MF A01.

Conclusions are: 1) Information obtained through interviews with 17 past and present installation personnel, installation records, shop folders, and field observations indicate that the Des Monies ANG Installation property has been used for disposal of small quantities of hazardous material in the past. 2) No evidence of environmental stress resulting from past disposal practices was observed at the Des Moines ANG installation. 3) In the priority listing of the three rated sites and their overall scores, the Facility 105 Vehicle Maintenance Fuel Tank, and the existing fire department training area, exhibit the most-significant potential (relative to the other Des Moines ANG Installation sites) for environmental concerns. 4) The old fire department training area located at Facility No. 228, is not considered to present significant concern for adverse effects on health or the environment.

704 (INIS-mf—11815, pp 7-72) **Resources of energy, energy consumption and environmental stress.** Waldner, W.F. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

From a global viewpoint, the following three targets are crucial for the Federal Republic of Germany to safeguard its energy supply: 1. Everyone of us must save energy. 2. In shifting energy needs 'away from oil', the aim must also in future be to make optimum use of a constant or even decreasing quantity of oil at a further increasing demand for energy. 3. Finally, the development of alternative energies must be essentially accelerated. Investments to that effect must be directed to such energy sources as can be made available, with certainty or a high degree of probability, within a relatively short period of time. (orig./HSCH).

705 (ORAU—88/A-73, pp 65-78) **Implications of new regulations dealing with hazardous materials.** Moreland, W.M.; White, D.A.; Wells, S.M. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

Several new regulations dealing with hazardous/radioactive materials must be followed in developing and implementing adequate training programs for DOE facilities that comply with the Resource Conservation and Recovery Act (RCRA), the Superfund Amendments and Reauthorization Act (SARA), the Hazard Communication Standard (HAZCOM), substance-specific regulations, and Department of Transportation (DOT) regulations. Facilities involved in the generation, storage, treatment, transportation, or disposal/removal of hazardous materials/waste must comply with all relevant training regulations. Each facility must determine if regulatory compliance is required based on facility function, the type of training required for specific categories of workers, and the level of training needed for each category of worker. This presentation outlines how the Environmental Compliance and Health Protection Technical Resources and Training (TRT) Program, working with environmental compliance, health protection, and waste operations groups at ORNL, has established specific training requirements to comply with DOE Orders and EPA, OSHA, and DOT regulations. 8 references, 10 figures, 3 tables.

706 **(ORNL—6450/R9) Environmental regulatory update table, September 1988.** Langston, M.E.; Nikbakht, A.; Salk, M.S. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 126p. NTIS, PC A07/MF A01. Order Number DE89001948/JAW.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the {ital Federal Register} and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

707 **(PB—88-238167/XAB) US EPA (Environmental Protection Agency) hazardous-waste-minimization program.** Freeman, H.M. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Aug 1988. 18p. (EPA—600/D-88/177). NTIS, PC A03/MF A01.

The passage of the 1984 Amendments to the Resource Conservation and Recovery Act marked a strong change in the United States' policies concerning hazardous wastes. In order to carry out the intention of the Amendments to reduce the generation of hazardous waste in the U.S., the EPA has developed a multi-faceted hazardous-waste minimization program. The program, which includes information gathering, research, development, and demonstration, support of state waste minimization programs, technology-transfer activities, waste-minimization assessments, and extensive communications with universities, states, and the general public, is discussed. The program described is focused on minimizing the generation of hazardous waste. However, the Agency believes that the waste-minimization concept can and should be applied to all releases to air, water, and groundwater.

708 **(PB—88-242722/XAB) Review of the Office of Research and Development's proposed budget for Fiscal Year 1988. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 6 Mar 1987. 39p. (SAB/EC—87/024). NTIS, PC A03/MF A01.

The scope of the Science Advisory Board's Research and Development Budget Subcommittee's review addresses three major issues: (1) trends in the research budget; (2) continuing core needs of EPA's research program; and (3) comments on specific research programs in eight major areas: air, radiation, water quality, drinking water, pesticides/toxic substances, hazardous wastes/Superfund, energy/acid rain and interdisciplinary research.

709 **(PB—88-242730/XAB) Review of the Office of Research and Development's proposed budget for Fiscal Year 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 14 Mar 1986. 32p. (SAB/EC—86/015). NTIS, PC A03/MF A01.

The Science Advisory Board believes that it can assist the Congress in developing a more-informed basis in reaching budgetary decisions for the Environmental Protection Agency's Office of Research and Development. The view is based on a large number of EPA research program evaluations that the SAB has conducted during the past several fiscal years, as well as to the experience of individual SAB members in carrying out or managing research, and their knowledge of EPA's research efforts.

710 **(PB—88-242748/XAB) Alternate Concentration Limit guidance together with two case studies demonstrating that guidance. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). Mar 1986. 14p. (SAB/EEC—86/010). NTIS, PC A03/MF A01.

See also PB—88-214267.

At the request of the Office of Solid Wastes (OSW), the SAB's Environmental Engineering Committee reviewed a draft Agency guidance for the establishment of Alternate Concentration Limits (ACL) for Resource Conservation and Recovery Act (RCRA) facilities, and two case studies demonstrating applications of the guidance. The Committee identified only obvious technical errors or omissions, which are explained in detail in the report.

711 **(PB—88-242961/XAB) Superfund Innovative Technology Evaluation (SITE) program: draft strategy and program plan. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). Jun 1986. 8p. (SAB/EEC—86/017). NTIS, PC A02/MF A01.

See also report dated Dec 86, PB—87-181939.

In October 1985 the Environmental Engineering Committee (EEC) expenditures were being made under Superfund without an adequate technological data base to support rehabilitation of both public and private hazardous-waste-disposal sites. The Administrator responded to EEP's resolution and stated that he agreed and noted that the Office of Research and Development (ORD) and the Office of Emergency and Remedial Response a strategy for a Superfund Innovation Technology Evaluation (SITE) Program to address some of the issues.

712 **(PB—88-868781/XAB) Hazardous-materials transportation. September 1982-September 1988 (Citations from the COMPENDEX data base). Report for September 1982-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 140p. NTIS PC N01/MF N01.

Supersedes PB—87-864955.

This bibliography contains citations concerning the transportation of hazardous chemicals, gases, explosives, and spent nuclear fuel. Liquified natural gas transportation is emphasized. Tanker ships, containers, and pipelines for these materials are discussed along with truck, rail, air, and submarine transportation. Safety programs and routing information are presented. Hazards specific to arctic shipping are included. (This updated bibliography contains 256 citations, 44 of which are new entries to the previous edition.)

2904 Natural Resources

REFER ALSO TO CITATION(S) 732, 1837

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 482, 511, 717, 732, 808, 820

713 **(DOE/ER—0391) Advanced energy projects: FY 1988 research summaries.** (USDOE Office of Energy Research, Washington, DC. Office of Basic Energy Sciences). Sep 1988. 34p. NTIS, PC A03/MF A01. Order Number DE89001167/JAW.

This report contains: Program Description; Summaries of Projects Active in FY 1988; Sample Statement of Work; FY 1988 Program Data; Small Business Innovation Research (SBIR) Projects; Investigator Index; and Institutional Index.

714 **(PNL-SA—16092) Technology transfer at Pacific Northwest Laboratory.** (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01. Order Number DE89001460/JAW.

Pacific Northwest Laboratory (PNL) manages an aggressive technology transfer program for the US Department of Energy (DOE) to help US industry implement the results of federally developed technologies. A benefit of this program is that PNL increases the use of results from its research programs and assists industries in solving technical problems, enhancing their productivity and international competitiveness. The technology transfer program began at PNL in 1981 with one person. Since then, it has evolved into an innovative organization that manages the deployment of technologies developed by the Laboratory's research and engineering centers. Technology transfer is a vital mission of the Laboratory.

715 **(UCRL—52000-88-9) Energy and Technology Review, September 1988.** Poggio, A.J.; de Vore, L.; Gleason, K.; Hendry, D.P.; Sanford, N.M.; Taft, S.O.; Van Dyke, P. (eds.). (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01. Order Number DE89001630/JAW.

This report briefly describes the following topics: Modeling Plasticity in a Two-Phase Ductile Material---We are using three-dimensional, finite-element modeling to study stress distributions in composite materials consisting of large strong particles in a ductile matrix; Understanding Particulate Flow Behavior---Discrete-particle computer simulations of the motion of idealized granules are helping us to obtain a microstructural understanding of the flow behavior of granular solids; Numerical Methods for Solving Ordinary Differential Equations and Differential/Algebraic Equations---We have developed efficient numerical techniques, implemented in

computer codes, that solve systems of differential equations arising in diverse disciplines. 45 refs., 23 figs., 1 tab.

716 **Research of new materials.** Horton, L.L. (Oak Ridge National Lab., Oak Ridge, TN (US)). *Mechanical Engineering;* **110**: No. 9, 44-49(Sep 1988).

In the past, technology transfer depended on individual research staff members. Today, these activities have greatly expanded. In this article, the author describes some of the ways the National Bureau of Standards and the national laboratories are transferring technology. User facilities, joint research programs and licensing are some of the methods being used.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 210, 214, 225, 652, 653, 743, 748, 1610, 1844, 2659, 2660, 2661, 2663, 2664

717 **(EML—516) The August 1986 through February 1988 radon intercomparisons at EML.** Fisenne, I.M.; George, A.C.; Keller, H.W. (Department of Energy, New York (USA). Environmental Measurements Lab.). Oct 1988. 36p. NTIS, PC A03/MF A01. Order Number DE89002248/JAW.

In this report, we summarize the results of the eleventh through fourteenth (August 1986, February 1987, July 1987, February 1988) radon intercomparison exercises sponsored by the Environmental Measurements Laboratory. Thirty-six groups including US federal facilities, and national and state laboratories participated in these exercises. The results indicate that the majority of the participants' results were within +-25% of the nominal value at ^{222}Rn concentrations ranging from 12 to 65 pCi L^{-1}. Two common difficulties, calculation errors and scintillation cell leakage, are discussed in terms of good practice. 5 refs.

718 (INIS-mf—11815, pp 113-178) **Nuclear energy and the public - analysis of a disturbed relationship.** Grupe, H. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

This work attempts to analyze the negative stance taken by parts of the population of the Federal Republic of Germany in view of nuclear energy. To the author, such a negative stance seems to spring from a disturbed relationship to today's state of knowledge and modern technology, particularly to the state of safety and to the true risk of nuclear technology. In his search for the reasons for these disturbances the author points out: how anxieties make man in our time feel insecure; how information deficits, half-truths and communication disorders provide a base of insecurity, what position is taken by the Kernforschungszentrum Karlsruhe in the so-called 'nuclear controversy'. By patient, detailed, and sincere information work, a large research center can, with the weight of its expert knowledge, help to inform the public. (orig./HSCH).

2908 Waste Heat Utilization

719 **(NLVF/S—700) Biomass fuels in district heating systems. Final report.** Otterstad, B. (Energidata A/S, Tiller (Norway)). (Norges Landbruksvitenskapelige Forsknings raad, Oslo). Feb 1987. 16p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755063/JAW.

The report deals with an energy conservation project on district heating. The project gives a cost comparison between a biomass fuelled system for the local water heating/electric power supply and the development of hydroelectric power. The computer program ESENTRAL is used in the simulation. 3 drawings.

2910 Conservation

REFER ALSO TO CITATION(S) 790, 791, 799, 800, 801, 803, 804, 826, 828, 829, 830, 831, 832, 833, 1485

720 **(BFR-G—17-1987) Energy replies 87. Questions and answers on energy conservation in buildings.** Oldin, M.B. (ed.). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 8 Nov 1987. 82p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755011/JAW.

The report accounts for important parts of today's knowledge of energy economy in buildings. Some of the report's messages: -Continue with energy conservation measures, -You can save a lot more, -Using today's technique the consumption of energy for space heating and hot water production could be halved. This would not only be economical but also lead to a better indoor climate and, most important, to a decreased destruction of environment. (O.S.).

721 (INIS-mf—11815, pp 514-540) **Possibilities of rational energy use.** Geiger, B. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

Rising energy demand, increasing energy costs especially since 1973, and the ecological impact of energy generation call more than hitherto for rational energy use. Rational energy use can be achieved by specific reduction of consumption. Within a period of 10 years, technical improvements, energy-technically appropriate operation modes and methods of building to preserve heat more efficiently, have brought about a slow but steady decrease in specific consumption. The examples mentioned document that consumers, by their choice of commodities, can have a considerable influence on energy consumption both in the home and in industry. (orig./HSCH).

722 (INIS-mf—11815, pp 541-561) **Energy industry - seized and missed chances for energy conservation in electricity and district heat generation.** Graeff, P. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The author deals with the wasting of energy in the Federal Republic of Germany and with the terms 'energy sources' and 'primary energy'. In his opinion, there is a need particularly to make use of waste heat, but solar energy, too, should be more fully exploited, especially to generate heat. The author finally expresses the opinion that power utilities have too little confidence in the appropriate techniques (solar heat and district heat). He claims that they take the wrong decisions because they use long-term forecasts as decision aids. In his view, they are repeating the state's mistakes as the maker of energy policy. The Federal German energy industry, he claims, does not come up to the country's technical and scientific level. (orig./HSCH).

723 (INIS-mf—11815, pp 562-578) **Energy supply in the Federal Republic of Germany dispensing with nuclear energy and petroleum.** Seifried, D. (Oeko-Institut, Inst. fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany, F.R.)). 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The scientist arrives at the following conclusion: Energy consumption could be cut down by the year 2030 to about 60 per cent respectively to one third of the current level by more efficient energy use and energy conservation, and by the use of renewable energies. To usher in the turn of the trend in energy, a number of obstacles have to be overcome. To that effect, the project 'Turning trend in energy - II' has devised an energy-political strategy. The basic idea underlying this energy conservation scenario is to reestablish municipal responsibility over energy supply, i.e. to raise the community to the rank of central political planning instance for energy use to suit local needs and make the most of energy consumed. (orig./HSCH).

724 (LBL—24213, pp 3.46-3.48) **Energy conservation policies for buildings in OECD countries: did they succeed?.** Wilson, D.; Tyler, S.; Ketoff, A.; Schipper, L. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

Energy conservation policy seeks to improve the efficiency of energy use by speeding up market forces or correcting market failures. In this project, the authors identify energy conservation programs which have given positive results, and why, in countries outside of the US. To analyze the potential transfer of foreign experience to the US, it is essential that specific government policies and programs are considered within their national contexts. The project covers government conservation programs for the residential sector in Canada, Denmark, France, Japan, Sweden, United Kingdom, and West Germany. The paper discusses results from Denmark, France, Japan and West Germany.

725 **(PNL-SA—15582) Energy use analysis for the Federal Energy Management Program.** Mazzucchi, R.P.; DeVine, K.D. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 8p. (CONF-8809103—7). NTIS, PC A02/MF A01. Order Number DE89001737/JAW.

From 5. annual symposium on improving building energy efficiency in hot and humid climates; Houston, TX, USA (13 Sep 1988).

Recent congressional legislation allows federal agencies new authorities to contract for energy savings by sharing the acquired savings with an energy service company. As part of its charter to make the federal government more energy-efficient, the Federal Energy Management Program (FEMP) endeavors to improve the technical basis for such performance-based contracting. Specific tasks include the development of improved energy use baselining methods, refinement of a simplified energy analysis method and support to users, preparation of guidelines and procedures for energy savings initiatives, and publication of a manual to guide identification and analysis of energy conservation measures. This paper describes the current status and planned progress in each of these areas, and how these relate to several planned shared savings projects. 6 refs., 2 figs., 2 tabs.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 76, 78, 79, 105, 106, 696, 723, 736, 744

726 **(FRCEA-TH—99) Macroeconomic effects of energy politics in Algeria.** Hireche, A. (Paris-9 Univ., 75 (France)). Dec 1986. 531p. (In French). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88755302/JAW.

The aim of this work was to evaluate the economical and financial effects of the algerian energy strategies between 1995 and 2010 and especially to compare two substitution strategies from oil production to natural gas production: keeping the same energy strategy but replacing oil by natural gas as the main exportation product and foreign currency generation, or a natural gas based energy strategy accompanied with energy conservation measures applied to oil as well as to natural gas utilization. Mathematical models are used.

727 **(FRCEA-TH—101-T-2) Economic growth and energy consumption.** Devezeaux de Lavergne, J.G. (Paris-1 Univ., 75 (France)). Dec 1986. 740p. (In French). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88755297/JAW.

In this second volume, the interrelations between energy and economics are modelized, using a tripolar scheme (energy as a production factor, as a consumption good and energy as a productive branch (production, importation of primary energy and transformation). It is then demonstrated that the global effect of the oil embargos on the french economy growth rate may be evaluated at minus 1 pc per year during 1974 - 1982. As the growth rate decrease during this period was a minus 2.3 pc, it can be said that the oil embargo effect is responsible of half of the growth decrease.

728 (INIS-mf—11815, pp 487-513) **Shifting the consumption of energy sources - possibilities and impediments.** Ederer, F. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

Substitution in the sector of energy signifies replacement of an energy source by another one or by a non-energy source, the replaced energy source being desirably one that is scarce and the replacing source, or sources, being ones that are less scarce. The following statement is made: a) Rising prices for oil lead to a drop in the quantity of energy consumed, b) rising prices for oil entail an increase in the consumption of other energy sources or a conservation of energy on the whole. From this, conclusions can be drawn on how to regulate energy consumption and the composition of energy consumed through aimed modifications of energy prices by taxation and subsidies. (orig./HSCH).

729 (INIS-mf—11815, pp 442-465) **Energy forecasts - methods, tasks, problems.** Ruehl, A. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The fact that experts making forecasts are, also in the sector of energy, frequently proved wrong must not lead one to reject their work. For one thing, forecasts are clearly a difficult matter in that they relate to the future; for the other, decision makers in energy policy and the energy industry do need some kind of a basis for their future-oriented action. Therefore, if criticism is voiced it must not be addressed to the making of energy forecasts as such. Furthermore, for the reasons mentioned in the preceding paragraph, care should be taken not to view forecasts from the angle of 'output' alone; rather, the different methods leading to the respective results must be subjected to a critical evaluation. (orig./HSCH).

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 110, 210, 660, 706, 717, 723, 724, 725, 731, 754, 790, 791, 800, 867, 870, 1485, 1765

730 (INIS-mf—11815, pp 374-389) **Law on the fuel and electricity industries (EnWG).** Richter-Ferenczi, M. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The paper deals with the following subjects: Importance of the 'Energiewirtschaftsgesetz - EnWG' (Law on the Fuel and Electricity Industries) with regard to the law on the whole; particular-

ities of energy supply as laid down in the EnWG; importance of and targets envisaged in the preamble of the EnWG; energy inspection activities as a form of state control, especially the permission to start businesses, control of investments, and ban on enterprises. (HSCH).

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 38, 60, 61, 78, 79, 82, 82, 83, 105, 106, 110, 114, 115, 117, 726, 751, 752

731 (LBL—24213, pp 3.48-3.50) **Energy interdependence: global issues and options.** Schipper, L.; Ketoff, A.; Sathaye, J. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

An informal meeting was organized by members of the Lawrence Berkeley Laboratory's International Energy Studies Group in Berkeley, on May 30, 1987, to discuss a number of issues related to key aspects of the world energy system. Twenty-eight representatives of academia, government, and the private sector from the Americas, Europe, and Asia participated in the meeting. It is now clear that oil supply and its price, as well as efficiency of use, may be only one part of the story, one whose relative importance is diminishing. There are other concerns that in the long term may be more serious. Most notable is the worsening global environmental impacts of energy use. The time scale for global environmental change through man's intervention, spurred by energy, is rapid in contrast with natural global climatic and environmental changes. The ecological and political time scales for responding to problems, once identified, are not well known. Topics at the meeting receiving the most attention are summarized. The consensus of the group was that a new approach is needed that will quickly sense global and regional changes in economies, geopolitical factors, and shifting demands for energy and its forms and sources. A new learning process could greatly improve their understanding of the linkages among energy, economic security, environment, and food. This forum will have as its primary responsibility the identification of issues and options, and the subsequent improvement of their learning and analytical tools to deal with them, in meeting the new kinds of energy-related problems they expect in the 1990's and beyond.

732 **Plumbing the earth's depth.** Traeger, R.; Smith, M.; Murphy, H. (Sandia National Lab., Albuquerque, NM (US)). *Mechanical Engineering;* **110**: No. 9, 62-69(Sep 1988).

Although the earth supplies us with energy, minerals, and food, and also receives most of our solid and liquid wastes, we know less about what lies 1000 meters beneath our feet than we do about the depths of the ocean or the outer reaches of space. When the energy crisis of the 1970s occurred, the national laboratories and industry began to work together on problems related to the production of energy from oil, gas, and geothermal resources. The alliance was successful because of the complementary strengths of its components. While the national labs offered advanced hardware and software, large-scale testing facilities, and a multidisciplinary approach, industry's perspective on economics and the marketplace provided the effort with a focus. The result was the development and commercialization of geotechnologies running the gamut from exploration and drilling to extraction and processing. This article describes some of these developments.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 867

2960 Electric Power

REFER ALSO TO CITATION(S) 80, 535, 750, 799, 803, 804

733 **(DOE/EIA—0226(88/07)) Electric Power Monthly, July 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 19 Oct 1988. 47p. NTIS, PC A03/MF A01 - GPO. Order Number DE89001830/JAW.

Temperatures in July 1988 were 8 percent warmer than in July 1987, and 15 percent warmer than normal (as measured by cooling-degree days), contributing to an increase in the demand for electricity. Accordingly, US electric utilities produced 257,048 gigawatthours of electricity in July 1988, establishing a new monthly record for total net generation. That record level of total net generation was 9133 gigawatthours or 4 percent more than the previous record (247,915 gigawatthours) set in July 1987. The higher demand for electricity was satisfied with increased fossil-fueled and nuclear-powdered generation. Coal-fired net generation, which represented the largest fuel share (56.0 percent), rose in July 1988 to 143,886 gigawatthours. This level of coal-fired net generation is the highest monthly level to date, breaking the monthly record of 143,503 gigawatthours set in July 1987. Corresponding to the record-level coal-fired net generation, coal stocks at the end of July 1988 declined to 148 million short tons, the lowest level since the end of August 1987, when coal stocks were 146 million short tons. Petroleum-fired net generation also experienced a healthy growth this month. This fuel source provided 14,058 gigawatthours of electricity, 12 percent more than in July 1987.

734 **(DOE/EIA—0397(88/2Q)) Electric power quarterly, April-June 1988.** (USDOE Energy Information Administration, Washington, DC). 17 Oct 1988. 303p. NTIS, PC A14/MF A01 - GPO. Order Number DE89001831/JAW.

During the second quarter of 1988, electric utilities in the United States generated 636,145 gigawatthours of electricity, a total of 14,986 gigawatthours (2%) more than the amount generated during the same period of 1987. From the first of April through the end of June in 1988, net generation from nuclear-powered units continued to be a major source of energy. Nuclear units produced 124,796 gigawatthours of electricity, a total of 20,398 gigawatthours (20%) more than during the second quarter of 1987. Net generation from nuclear plants represented 19.6% of the total electricity produced during the second quarter of 1988. During this period, one nuclear unit, the Braidwood Plant (Unit 2) became operable; it has a net summer capability of 1107 megawatts. This unit, located in Illinois, is operated by the Commonwealth Edison Company, which owns and operates 12 nuclear units (more than any other electric utility in the United States). This unit represented 40% of the total net summer capability (2797 megawatts) that become operable during the second quarter in 1988. Output from coal-fired plants during the second quarter of 1988 was 355,693 gigawatthours, 2% more than the amount generated for the second quarter of 1987. In April and May of 1988, two new coal-fired units became operable, providing an additional 1030 megawatts of net summer capabilities. 9 refs., 1 fig., 15 tabs.

735 (EPRI-P—5993, pp 8.1-8.6) **Restructuring in the natural gas industry.** Daigneault, P.A. (Transco Gas Co., Houston, TX (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

This paper summarizes the FERC actions that are changing the natural gas industry and briefly addresses their implications for the electric utility industry. There is no question that those who can meet the challenges of today's natural gas market will find the opportunity to prosper. The key is understanding the basic nature of the market and its response to regulatory developments. The paper describes FERC orders (#380, 451, 436, and 500), then discusses the implications for electric utilities, electric utility demand, and challenges faced by both electric utilities and the natural gas industry.

736 (EPRI-P—5993, pp 15.1-15.4) **Fuel management and financial results.** Doudiet, J.T. (Dean Witter Reynolds Inc., New York, NY (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

The author's direct involvement with the technical aspects of the fuel market is quite limited, having spent many years in financial positions with electric and gas utilities. He has seen how fuel strategies and decisions have affected the financial results of

these companies and here discusses how the fuel manager should interact with senior management in creating and implementing fuel supply strategies that maximize the positive aspect of his profession on the company and minimize any negative outcome. It is possible that positive financial results may depend on successful fuel management more than ever. The paper describes fuel management before 1973; describes how it has changed after 1973 and what that means in dealing with senior management; and observes the dual nature of the fuel management decision as senior management sees it. There is the macro decision, dealing with questions relating to what kind of fuel to burn and the micro decision, dealing with questions about how to arrange for fuel to be utilized.

737 (EPRI-P—5993, pp 16.1-16.7) **Strategic fuel planning.** Milligan, A.J. (Southern Co. Services, Birmingham, AL (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

Traditional fuel planning has been around a long time. Fuel planners have always projected fuel prices, forecasted burns, and developed budgets. But are they really involved in the strategic fuel decisions within the company? The purpose of this paper is to discuss briefly what other utilities are doing in this area, as well as the process used by the Southern Company Services to develop a strategic fuel plan. Strategic fuel planning is the process of fitting the fuel opportunities of today with the objectives of the organization. A strategic fuel plan should precede the long-range tactical plan. The strategic planning process also provides an opportunity to question basic assumptions about the fuel supply system. An indicator of what is strategic to a company is the level of attention an issue receives. Fuel is the major variable cost on a typical system and should receive appropriate attention from the highest level of management. A junior assistant fuel planner cannot formulate a strategic fuel plan for his company. Strategic fuel planning is important today because of the level of competition they are facing and anticipate in the future. Small things done right in fuel procurement can have big impacts. Decisions about fuel will have material consequences on profitability ten years from now.

738 (EPRI-P—5993, pp 17.1-17.8) **Strategic planning at TVA.** Harmon, G.F. (Tennessee Valley Authority, Chattanooga (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

Although the TVA generating system is composed of combustion turbines, pumped storage, hydro, and nuclear, the largest share (55 percent) is coal-fired. The eleven working plants are in three states and receive most of their coal supply from the Illinois basin and Appalachian coal fields. A diversity of transportation modes and sulfur dioxide limits exist at these plants. Delivered coal costs are a major factor in determining which plants will have to absorb uncertainties in load forecasts and generation from other TVA facilities. In recent analyses of how TVA would comply with acid rain legislation, it was concluded that coal price assumptions (premiums for low sulfur coal or the differential in prices between compliance and scrubber coals) significantly affected the optimal strategy.

739 (EPRI-P—5993, pp 18.1-18.9) **Strategic fuel planning at San Diego Gas and Electric Company.** Innes, R.W. (San Diego Gas & Electric, CA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

San Diego & Electric (SDG & E) is a small utility compared to its California neighbors. The company can take advantage of its compact size by moving quickly to capitalize on fuel market opportunities. The long-term strategic fuel planning section consisting of four people was formed in 1982. This group deals indirectly with short term regulatory issues, but concentrates mostly on identifying underlying forces that drive fuel markets. In long-term planning, it is generally not very productive to design computer models with great detail since data accuracy beyond a few months is very questionable. Instead, SDG & E tries to use knowledge of the underlying forces to identify limits to market conditions. Fuel planning is an interactive process with many starting points such as a forecast, problem, new law, or company goal. All of these inputs interact within the fuel planning process to generate the published Fuel Plan, which contains policy statements about SDG & E fuels. This is not a linear process. Many ideas that are pursued are not necessarily part of the final plan. Often the objective must be restated many times before the problem is finally resolved. The final step in any fuel planning study is thorough documentation. At SDG & E, this documentation is the Fuel Plan. This paper discusses the planning process.

740 (EPRI-P—5993, pp 19.1-19.6) **Planning around uncertainty.** Mahoney, J.V. (New England Power Co., Westborough, MA (USA)). Aug 1988. Unlimited audience, publicly available. Research Reports Center, Box 50490 Palo Alto, CA 94303. Order Number TI88015400/JAW.

In Proceedings: 1987 fuel supply seminar.

If the past 15 years have taught them nothing else with regard to planning a fuel procurement strategy, they have taught them a lesson long known to investors - diversity and flexibility are essential. Because many of the uncertainties facing an individual utility are unique to the region or the company, a plan that may provide diversity and flexibility to one may seem constricting and rigid to another. For example, in structuring a strategy for dealing with the uncertainty of potential price changes among fuels, a utility's mix of thermal generating capacity (coal/oil/natural gas), its proximity to indigenous supplies, and its customer load characteristics are unique features. Fuel planning and the actual process of fuel procurement now involve more interaction, and across more utility functions, than ever before. The motivation is strong, however, to undertake this challenge and to develop a successful, winning effort. For most utilities, fuel costs are the single largest component of the costs of electricity to their customers. Within New England Power Company, 23% of their total cost per kilowatt hour is associated with fuel purchase, delivery, storage and handling. Conditions unique to New England Power Company and their planning process are discussed.

741 (INIS-mf—11815, pp 108-112) **Regional load distribution - an important element in electricity supply.** Lupberger, B. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

To assure adequate power supply at any time, public utilities must not only dispose over an appropriate capacity and an adequate supply network. Further needed are central coordination and monitoring facilities assuring that power generation meets demand at any given time and that the energy produced will reach the consumer safely. (orig./HSCH).

742 (INIS-mf—11815, pp 73-107) **Tasks and structure of the power industry.** Rickinger, E. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The task of the electricity industry according to this paper is to supply power as safely and cheaply as possible and, in recent years, with a minimum of environmental pollution; any conflicts arising between these different targets must be weighed and solved by the power industry and by political means. Safe power supply comprises technical safety and reliability of supply. The planning of the future is another important aspect, for the demand of electricity must be adequately assessed if electricity supply is to be put on a reliable basis in the years to come. (orig./HSCH).

743 (INIS-mf—11815, pp 390-404) **Licensing procedure for the construction of power utilities.** Sturm, C. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The requirement to obtain licences for plants constitutes a form of state control over the construction of power utilities. Under the Federal Pollution Law and the Atomic Energy Law, only the environmental compatibility of the planned plant is verified. Verifications according to the Law on the Fuel and Electricity Industries and the Federal Pollution Law, respectively the Atomic Energy Law and the Law on Power Generation from Coal are effected independently of one another by the different authorities. The granting of licences for the individual power plants may be subject to different laws in each instance. This paper covers only the licensing procedure under the Federal Pollution Law and the Atomic Energy Law. (orig./HSCH).

744 (LBL—24213, pp 3.45-3.46) **Electricity utilities in the OECD: energy secure?.** Hawk, D.; Schipper, L. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

Coming out of the 1970's, many utilities recognized the need to establish mechanisms (if not already in place) to anticipate change and respond to it in a controlled, constructive way, thereby maintaining the stability and/or security of electric supply. In this work the authors investigate the ability of the electricity supply systems in five European countries - France, Germany, Italy, Sweden and the United Kingdom - to respond to changes in the accessibility of energy inputs or the operability of generation facilities. Accessibility and operability could be determined by economic, political or technical conditions. The paper briefly describes what each system looked like in 1972-1973 and their immediate (short term) responses to the oil shock of 1973. It then explains how the systems have evolved since and in response to the shock, by default or through deliberate utility planning.

745 (LBL—24213, pp 3.51-3.53) **Designing auctions for the purchase of electric power by utilities under PURPA.** Rothkopf, M.H.; Kahn, E.P. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The Public Utilities Regulatory Act (PURPA) requires there to be procedures for electric utilities to buy electric power from qualifying cogenerators and small power producers (QFs) at rates up to avoided cost. This has led to price-posting procedures at prices calculated as the utility's marginal cost. Unexpectedly large sales at these prices and slow adjustment to falling energy cost are partially responsible for payments to QFs in excess of the utility's true avoided cost. Using competitive bidding instead of posted prices has been proposed as a way to avoid this outcome. The authors have written a report that reviews bidding theory and explores four issues that arise in designing auction systems for the purchase of power from QFs under PURPA. One of these four issues is the choice of auction format between progressive oral auctions, Dutch oral auctions, standard discriminatory or first-price sealed bidding (if you win, you get paid the amount of your bid), and nondiscriminatory or second-price sealed bidding (all winning bidders are paid the amount of the best losing bid). Another issue is the extent to which non-price factors influence the auction and the manner in which they do. A third issue is the way in which bid acceptance procedures deal with the discrete quantities of power offered by different bidders. The fourth issue is the frequency of auctions. After discussing these issues, the report explores practical details through a case study of a PURPA auction using publicly available data representative of conditions facing Southern California Edison Company. This report is summarized here.

746 (NERC—9001903) **1988 electricity supply & demand: Annual data summary for 1988-1997.** (North American Electric Reliability Council, Princeton, NJ (USA)). Oct 1988. 164p. North American Electric Reliability Council, 101 College Road East, Princeton, NJ 08540-6601.. Order Number TI89001903/JAW.

The North American Electric Reliability Council (NERC) annually collects and publishes ten-year projections of electricity supply and demand of the nine Regional Reliability Councils. This Electricity Supply and Demand report provides this data for the 1988-1997 period. The projections were developed by the nine Regional Reliability Councils and reflect conditions as of January 1, 1988. Data on peak demand, net energy for load, capacity resources, capacity margins, and planned additions and retirements of generating units have been extracted from the April 1, 1988 Coordinated Bulk Power Supply Program (IE-411) reports submitted to the US Department of Energy (DOE) by each Regional Reliability Council. Data on generating capacity, electrical energy production, fossil fuel requirements, planned conversions of units from oil to coal, and existing and planned additions of transmission lines were reported by the Regional Reliability Councils directly to NERC.

747 (PB—88-235387/XAB) **Large-system reliability analysis. Final report.** Fink, L.H.; Carlsen, K.; Erkmen, I. (Carlsen and Fink Associates, Inc., Fairfax, VA (USA)). Aug 1985. 38p. NTIS, PC A03/MF A01.

This report outlines a new approach to power system reliability evaluation calculated to provide a computationally feasible, comprehensive reliability index suitable for screening analysis. The results show that effective reliability analysis in a screening sense can be performed on large electric networks with a very modest computational effort. The reduction in computational requirements over available and proposed analysis techniques is by more than two orders of magnitude. Availability of this capability would allow the utility planners to analyze a large number of alternative plant expansions and system conditions.

748 (STEV—1988-5) **Electric space heating and the nuclear power phaseout. On the need for control.** (Statens Energiverk, Stockholm (Sweden)). Dec 1987. 79p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755084/JAW.

The report discusses how the Swedish nuclear power phaseout will affect the large share of the electricity use that consists of electric space heating. 1985 the electric space heating consumption amounted to 31.5 TWh, 20.5 TWh of which was used in one-family houses. It is important that adjustment to the future, higher, prices of electricity starts soon, well in advance of the reactor shutdown. Technology for replacement of electric heating equipment is reviewed, price and consumption prognoses are given, and methods for changing the consumption patterns and helping the substitution of heating systems are discussed. (L.E.).

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 733, 746, 765, 813

749 (AD-A—196434/5/XAB) **Modeling energy consumption in the Defense Logistics Agency. Final report, November 1986-December 1987.** Hobson, J.J. (Defense Logistics Agency, Alexandria, VA (USA). Operations Research and Economic Analysis Office). May 1988. 28p. NTIS, PC A03/MF A01.

The Defense Logistics Agency (DLA) Office of Installation Services and Environmental Protection was tasked with developing goals for energy consumption at each of the DLA-managed facilities. These goals could be based on factors that beyond the control of the organization and can vary from month to month, such as weather conditions and workload. This report presents the results of an analysis that mathematically modeled energy consumption and then attempted to use these models to assist in setting consumption goals for the agency. The DLA facilities identified the factors they considered to be predictors of energy consumption. Three years of monthly data were submitted for each factor. The data

were screened to identify possible problems and to determine which factors had some relationship with energy consumption. Regression models were developed to predict total consumption, electric consumption, and non-electric consumption at each location. These models showed a definite relationship between weather and workload factors and energy consumption. However, the models were not accurate enough to be used to set consumption goals in DLA due to the impact of extraneous factors that were not quantifiable. Goals for energy consumption should be flexible to allow changes when unusual weather or workload conditions exist. However, these goals cannot be derived through a precise mathematical formula given the existing detail of available data.

750 **(DOE/BP—947) Financial highlights: Federal Columbia River Power System for the fiscal year ended September 30, 1987: Financial summary.** (Bonneville Power Administration, Portland, OR (USA)). May 1988. 56p. NTIS, PC A04. Order Number DE89001542/JAW.

The financial conditions experienced by BPA during 1987 included: one of the worst water years in a century---the tenth lowest water runoff in 62 years of record---that caused curtailment of surplus energy sales and commensurate revenue declines for six months (from February through August); extra-regional demands for access to low-cost BPA power; tougher competition from inside and outside the region with continuing surpluses of electricity and other energy; an unusually mild climate year and reduced demand for electricity; and mounting customer dissatisfaction over BPA rates, and concerns about future rate stability. Revenues of $1674 million in 1987 were down $114 million from 1986 revenues of $1788 million. They were $371 million below planned revenues for the year based on rates set in 1985. Prompt and effective management action was required to ensure BPA's scheduled payments to the US Treasury.

751 **(NEI-SE—21) Coal-87. Report on on-going and planned coal-use.** (Statens Energiverk, Stockholm (Sweden)). 30 Oct 1987. 48p. (In Swedish). NTIS (US Sales Only), PC A0403/MF A01. Order Number DE88755055/JAW.

The coal and coke use in Sweden during 1986 is reviewed in this report. All plants that use more than 1000 tons of coal annually are listed. The total consumption of coal for energy purposes was 2.7 Mtons, 1.9 Mtons of which were consumed by district heat and power plants. The consumption of metallurgical coal amounted to 1.7 Mtons. The mean import price 1986 was 316 SEK/ton (about $ 49/ton). Coal market developments during 1987 are noted, as well as planned installations using coal. (L.E.).

752 **(NEI-SE—23) Energy and electricity consumption 1985-1997-2010.** (Statens Energiverk, Stockholm (Sweden)). 11 Nov 1987. 79p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755057/JAW.

Prognoses of the energy and electricity consumption are made in the light of the Swedish phaseout of nuclear power, which should be finalized by year 2010. The total energy supply is calculated to be 1985 - 450 TWh, 1997 - 465 TWh, and 2010 - 510 TWh. Concerning the different fuels, the largest changes will occur for coal and natural gas, which will increase from 8 to 24 percent and 0 - 4 percent of the fuel supply, respectively, from 1985 to 2010. (L.E.).

753 **(SBI-R—195) Energy and housing consumption of different households.** Budde, J. (Statens Byggeforskningsinstitut, Hoersholm (Denmark)). 1988. 68p. (In Danish). Statens Byggeforskningsinstitut, Postbox 119, DK-2970 Hoersholm.

EFP-86; EFP-87.

A grouping of the Danish households has been made in order to ascertain which factors influence the total consumption and parts thereof. The following factors were studied: The connection between consumption and the available income, the total consumption, number of persons of the household, number of children living at home, the age of the person earning the highest salary, as well as of different groups according to their social status. If the job status of the principal wage earner is used as criterium, the trade groups who had a particular high energy consumption were the self-employed farmers followed by the self-employed persons of the towns. The energy expenditure increases for the different trade groups in relation to the increasing available income, but the share of the total consumption decreases. If a division is made according to urban conditions it is the households of the rural districts and in small urban areas who account for the largest energy consumption. If a division is made according to counties, the largest energy consumption has been registered in the counties of Sealand, Storstroem and Bornholm followed by the households of the metropolitan area (with the exception of Copenhagen and Frederiksberg). Also the connection between consumption and housing conditions dependent on ownership of dwellings and available income has been studied. (LN).

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 511, 1614, 1796, 2195

754 (LBL—24213, pp 3.44-3.45) **Renewable energy technologies in the developing countries: a reassessment.** Sathaye, J.; Meyers, S. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

Renewable energy projects in the developing countries have been supported by international lending and development agencies, by foreign assistance agencies in the industrialized countries, and by the developing countries themselves. The US Agency for International Development (AID) has been involved in, or is currently supporting, over 200 programs which contain significant renewable energy components. Although there have been successful projects, the results have generally been much less promising than anticipated. The AID Office of Energy has been conducting a critical reassessment of AID's experience with renewable energy technologies. The reassessment is intended to clarify lessons learned and to help in setting future directions. LBL has assisted in this effort. Findings to date are discussed.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 834, 834

755 **(AD-A—195971/7/XAB) Unified study of plasma/surface interactions for space power and propulsion. Final report, 15 July 1987-29 February 1988.** (R and D Associates, Alexandria, VA (USA). Washington Research Lab.). 29 Feb 1988. 66p. NTIS, PC A04/MF A01.

High-specific-impulse, high-specific-power devices, such as magnetoplasmadynamic arcjets, laser or microwave propulsion channels, and MHD generators, involve the flow of modest temperature (0.5 - 5 eV) partially ionized gases at speeds of 5 - 20 km/sec. The interactions of such flows with solid surfaces containing, channeling, or penetrating the flow provide a principal source of concern for the efficiency and lifetime of high-specific-power systems. This report describes a basic research effort that examines the plasma/surface interaction experimentally in an arrangement providing diagnostic access usually unavailable in mission-oriented, device-development projects.

3003 Thermoelectric Generators

756 **(AD-A—195750/5/XAB) Feasibility of controlled rate of release of energy by nuclear alpha-emitters. Final report, December 1987-June 1988.** Sparrow, D.A. (Institute for Defense Analyses, Alexandria, VA (USA)). Jun 1988. 16p. (IDA-M—442). NTIS, PC A03/MF A01.

Energy is approximately one million times more densely stored in atomic nuclei than in chemical bonds. This has been exploited in nuclear reactors which can supply varying amounts of electric power, but which have a minimum size, and in radioisotope

thermoelectric generators (RTGs) which can be small, but have very limited power range despite their large energy density. This paper looks at some possibilities for externally varying alpha-decay rates, in an attempt to design an RTG which would be a light, compact, variable electric power source for space applications with peak power much greater than presently available. The author considers using alpha particles to stimulate decay and microwave absorption to reduce the angular momentum barrier and hasten spontaneous decay. Neither of these approaches seems feasible.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 676, 683, 685, 691, 1065

757 **(AD-A—196463/4/XAB) Engineering quarterly review. Quarterly report for October-December 1987.** Mohanta, S. (Aquanautics Corp., Emeryville, CA (USA)). 1 Feb 1988. 4p. NTIS, PC A02/MF A01.

To demonstrate the technology of oxygen extraction from seawater by designing an underwater vehicle powered by a fuel cell and oxygen supplied by Aquanautics system. Major improvements were achieved in the power-output relationship of the electrochemical cell. A tenfold increase in output (from 0.15 1 sq. cm of cell to 1.5 1 sq. m) at a given power input (100 watt-min/1). This has been due to: 1) use of higher-conductivity carrier solution; 2) use of electrocatalysis; and 3) optimization. Oxygen produced at such operating conditions has been used in an Al-O_2 fuel cell in a small-scale integration.

758 **(AD-A—196989/8/XAB) Oxygen chemistry. Technical report, 1 January-31 August 1987.** Buckenham, N.R. (Aquanautics Corp., Emeryville, CA (USA)). 31 Aug 1987. 9p. (AFIT/CI/NR—88-111). NTIS, PC A02/MF A01.

The Project objective was to demonstrate the technology of oxygen extraction from seawater by designing a submarine powered by a fuel cell and oxygen supplied by Aquanautics system. A new cell-design concept has been introduced where the carrier fluid flows through the felt in a direction perpendicular to membrane separator. This allows much lower pressure head and therefore lowers pumping costs since the fluid velocity and path length are small. The fluid also passes through all the electric potentials of the electrodes.

759 **(CONF-881010—1) Fuel cells for vehicle propulsion applications: A preliminary comparison.** Kumar, R.; Krumpelt, M.; Myles, K.M.; Nelson, P.A. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01. Order Number DE89000589/JAW.

From 11. fuel cell seminar: development and application of fuel cells for the 90's; Long Beach, CA, USA (23 Oct 1988).

Fuel cells are being considered seriously as a potential replacement for internal combustion engines in buses, vans, and ultimately passenger cars. Concern for air quality in urban areas, the possibility of better fuel efficiency, and the prospect of using coal- or biomass-derived alcohols rather than imported oil as fuel are the major motivations. The challenges are to reduce the capital cost of the fuel cell systems and to adapt them for automative use. This study was conducted to make a preliminary comparison of the major types of fuel cells for vehicle propulsion applications. Simplified schematic flow sheets were devised for different fuel cell types. These flow sheets were then used for thermodynamic analyses. Other factors investigated include startup, transient response capability, and system complexity, but no attempt was made to analyze system behavior with reference to any specific driving cycle. For these analyses, fuel cell systems of 60 kWe (gross) were used, equivalent to the {approximately}55 kWe battery systems required for advanced electric vans. Four fuel cell types were considered in this study: phosphoric acid (PAFC), proton exchange membrane (PEM), molten carbonate (MCFC), and monolithic acid oxide (MSOFC). Although an experimental van has been successfully operated with an alkaline fuel cell on bottled hydrogen fuel in Europe, this type of fuel cell was not considered in this study. In our view, the alkaline fuel cell is not compatible with alcohol fuels because of the CO_2. 3 refs., 4 figs.

760 **(PB—88-868021/XAB) Fuel cells. August 1985-August 1988 (Citations from the NTIS data base). Report for August 1985-August 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 127p. NTIS PC N01/MF N01.

Supersedes PB—87-865721.

This bibliography contains citations concerning the development and utilization of fuel cells for energy production and storage. Topics include system descriptions and evaluation, theoretical aspects, and design and fabrication considerations. Molten carbonate and phosphoric acid fuel cells are among the types considered. (This updated bibliography contains 179 citations, 17 of which are new entries to the previous edition.)

761 **Fabrication of fuel cell electrodes and other catalytic structures.** Smith, J.L. US Patent Application 6-013,472. 11 Feb 1987. 15p. Contract W-31109-ENG-38. NTIS, PC A03.

A porous layer of catalyst material suitable for use as an electrode in a molten carbonate fuel cell includes elongated pores substantially extending across the layer thickness. The catalyst layer is prepared by depositing particulate catalyst material into polymeric flocking on a substrate surface by a procedure such as tape casting. The loaded substrate is heated in a series of steps with rising temperatures to set the tape, thermally decompose the substrate with flocking and sinter bond the catalyst particles into a porous catalytic layer with elongated pores across its thickness. Employed as an electrode, the elongated pores provide distribution of reactant gas into contact with catalyst particles wetted by molten electrolyte. 1 fig.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 721

762 **(AFME-FR—24) Energy conservation technical and scientifical state of the art report.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754973/JAW.

The first chapter is concerned with the technical state of the art in the domain of energy conservation: heat aspects in housing, industry and agriculture, transportation and engines aspects, fuels and combustibles from biomass, non-centralized electricity production and rational electricity utilization. The second chapter is concerned with raw materials conservation and optimal utilization: mineral, cellulosic and textile raw materials, metals, polymers and composites, ceramics and high-temperature composite materials.

3201 Buildings

REFER ALSO TO CITATION(S) 494, 697, 725, 899, 1181, 1219, 1307, 1675, 1677, 1692

763 **(AFME—84-2150-2) High performance window block with sliding shutters.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 33p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755315/JAW.

A window-block or module has been developed: it is composed of a rigid PVC frame filled with insulation foam, a double glazing and airtight and insulating swinging shutters. The objectives of the study were to reduce the thermal transfer coefficients of the building by optimizing the window and shutter design and selection as a function of the orientation and climatic conditions. A thermally optimized sliding shutter has been also developed and tested.

764 **(AFME—85-04-1217) Energy conservation in buildings; an evaluation of the potential utilization of holographic devices.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 99p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755314/JAW.

An evaluation of the potential application of holographic materials to energy conservation in buildings is presented. The main application could be holographic films used to modify the energy and light transmission properties of the glazings in order to reduce energy consumption for indoor lighting, space heating and air conditioning. The economic profitability of such devices in France is rather not very promising.

765 **(BFR-G—16-1987) Energy in built-up areas. Prospects of the nineties.** Engstroem, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 184p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88755010/JAW.

Since 1984 several large and important R and D projects have been completed. The Council for Building Research has compiled the results in this report. The report shows the change in energy consumption in houses and premises from the early seventies and on. In particular the electricity consumption is reviewed. Main headings of the report: -Energy policy and energy directed building research 1975 to 1987, -Energy in built-up areas, state of the art and research frontline in 1987, -The energy consumption in buildings, -Potential for energy conservation and more effective use of energy, -Strategical energy issues in the built-up environment, -Future need for R and D and R and D structure. (With 137 refs.) (O.S.).

766 **(BFR-R—10-1988) Stockholm-project. Glassed yards and heat transfer from offices to flats at Bodbetjaenten block.** Andersson, L.O.; Delsenius, S.E.; Nyman, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). Nov 1987. 80p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755014/JAW.

This report shows the development of the project from idea to finished building and the administration during the first year. The building consists of 41 flats surrounding a glass covered yard. The southern front is also glassed. Towards the north side of this yard is another glassed yard surrounded by offices. The utilized area-apart from the yard - is about 6600 sq.m. of which about half the area consists of flats. Energy consumption as calculated by the computer is compared with real consumption. (L.F.).

767 **(BFR-R—18-1988) Ground water based heat pump system for 193 row-houses. Operative experience 1984-1986.** Landberg, J. (Viak AB, Malmoe (SE)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). Nov 1987. 49p. (In Swedish). NTIS (US Sales Only), PC A03. Order Number DE88755016/JAW.

The aim of the project has been to collect and evaluate operational experiences from a four year period of a ground water based heating plant in southern Sweden. The plant which has a capacity of 1.1 MW was operational during autumn 1983 and has since then provided heat for 193 row houses. The result of the study among other things shows: -A saving of SEK 485 000 during the year 1985 compared with municipal heating, -A pay off time of 5 years for the plant which is somewhat longer than expected, -A higher degree of cooling of the ground water than indicated by the theoretical study. (L.F.).

768 **(BFR-R—28-1988) Outlet air heat pumps in a two-storey residential building at Bojsenburg in Falun. Evaluation of measurements for two years.** Persson, S.E. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 107p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755019/JAW.

Trial outlet air heat pumps has been installed in 8 of the houses. The block was erected 1974-1978 and heating is entirely based upon electric power. In order to find out the most suitable technique 4 of the 8 houses were equipped with heat pumps for indirect evaporation and 4 for direct evaporation. The report shows the results from measurements from two years of operation. The last of these years, 1986, the heat pumps for indirect evaporation have delievered energy for hot tap water with a heat factor of 2.2 for the heat pumps as a unit. For the entire system however, the heat factor is as low as 1.4 with a covering degree of 77%. During an estimated 10 years' period these heat pumps tend to reach a net loss of SEK 100 000 compared with a calculated gain of SEK 88 000. During the same year the heat pumps with direct evaporation have delivered hot tap water with a heat factor of 3.0 for the heat pumps as a unit. For the entire system the heat factor is 2.6 with a covering degree of 91%, which ought to give a gain of SEK 124 000 during the estimated 10 years period, which corresponds exactly with the calculated gain. The report shows that heat pumps for direct evaporation are economically favourable and are recommended to be installed in the remaining 84 houses of the block. (L.F.).

769 **(BFR-R—36-1988) Practical experiences of glazed courtyards. A survey of 26 projects in service.** Carlson, P.O.; Lindquist, E. (Arne Johnson Ingenioersbyraa AB, Stockholm (SE)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 115p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755021/JAW.

The intention has been to obtain an overview of the problems which have been encountered and their extent. The survey shows that there is considerable lack of knowledge and competence in regard to the design and construction of glazed courtyard projects. Owing to these shortcomings, technical problems of different kinds have been rather the rule than the exception, and the quality of the constructions put up is to low which may involve extra expenditure for future operation and maintenance. In spite of this, glazed courtyards are perceived almost without exception as a positive addition to the environment and the activity carried on. The results of the survey are given in the form of examples of usual problems and a check list of important aspects which must be taken into consideration in a glazed courtyard project. The report is intended for clients, property managers, architects, designers, contractors, material suppliers, researchers, students and trade organizations who, in one way or another, come into contact with or are engaged in glazed projects. (authors).

770 **(BFR-R—37-1988) Efficient use of electrical energy in housing estates with the aid of power monitoring systems.** Kiluk, C.; Nilsson, M.; Isacson, Oe. (Mimares AB, Stockholm (SE); Stand-In AB, Baalsta (SE)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 75p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755022/JAW.

The object of this preliminary study has been to chart and verify the economic and technical conditions for the establishment by the power supply undertakings of a power monitoring system for control of power consumption in housing estates. It was also of interest to formulate and evaluate appropriate calculation methods. The aim was to formulate and structure a programme of action for the main project, 'Effective use of electrical energy in housing estates with the aid of power control systems'. The results of this preliminary study confirm it is possible to establish and to run profitably, on a large scale, a centrally controlled power monitoring system. The profitability arises from the fact that the high voltage based power charges will be lower. The economic justification for the establishment of the system is further reinforced by consequential effects such as lower transmission losses and reduced environmental effects. Both these are consequences of a reduction in the need for generation capacity. (authors).

771 **(BFR-R—45-1988) Introduction of domestic heat pumps. Organisational aspects.** Baave, E. (Royal Inst. of Techn., Stockholm (SE). Dept. of Building Economics and Organization). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 55p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755025/JAW.

The introduction of domestic heat pumps in Sweden started in 1974, reaching a peak at the beginning of the 1980s. By 1985, about 3.5% of the non-apartment-building stock of residential build-

ings possessed heat pumps. Regional variations occur. The reason for the major difference in penetrations at local level is to be found in the level of interest of local authority energy advisers and heat pump sales companies. The number of manufacturers and types of heat pumps increased rapidly up to 1985. On the other hand, lack of knowledge on the part of installers and others contributed to shortcomings in the day-to-day performance of domestic heat pumps and increased the need for service. Since the original expansion in the numbers of manufacturers and general agents at the beginning of the 1980s, many companies have ceased manufacture of heat pumps or gone out of business, which has made it difficult for owners of heat pumps to obtain spare parts.

772 **(BFR-R—46-1988) Earth heat for the Groevelsjoen mountain lodge. An evaluation.** Hjort, P.A. (VIAK AB, Malmoe (SE)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 68p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755026/JAW.

The objective of this work has been to investigate the performance of a 220 kW (thermal outpu) heat pump abstracting heat from marshy ground, and to compare the results with the expected design performance. The work shows that too large a heat pump has been installed, with the result that the heat production has been about 40% lower than expected. Oversizing of the heat pump has also resulted in its coefficient of performance being lower than expected. This has in turn reduced the amount of heat supplied by the ground collectors, to about 30 kWh/m/sup 2/ as against an expected 50 kWh/m/sup 2/. With the present loading of the collectors, the ground seems to recover completely during the summer. However, certain factors indicate that annual heat abstraction should not exceed 30-40 kWh/m/sup 2/. In terms of operating economics, there has been a net saving of about SEK 130000 per year relative to the cost of an electric boiler.

773 **(BFR-R—65-1987) Investment costs for installation of heat pumps in blocks of flats.** Bodinson, L.; Sjoeberg, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 20p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755028/JAW.

The costs were to be shown for different heat sources normally used. The price development for heat pump installations during the period 1983-1985 was investigated as well as differences in costs between different parts of the country. All in all there were about 650 objects which were analysed. Costs for the most common heat sources (outdoor air, rocks, ground water, water in lakes, earth and exhaust air) had to be produced. Each heat source was divided into five grades with reference to the produced heat effect: 0-15, 15-30, 30-100, 100-500, >500 kW. In order to show the distribution of installation costs they were presented as average values for the heat pumps included in 90% of each group. The cost distribution was very high and a significant tendency was not to be seen but it seems to be cheaper to install heat pumps in the southern part of the country. (L.F.).

774 **(BFR-R—68-1987) Operating characteristics for parallel-connected consumer service units for district heating.** Frederiksen, S.; Wollerstrand, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755029/JAW.

This report describes parallel-connected and two-stage-connected consumer service units for district heating having indirect connection of a radiator circuit and with a domestic hot water circuit without closed loop water circulation. Using calculated operating characteristics, the differences in primary (district heating) return water temperatures and primary flow rates were calculated for the two arrangements. The following practical results of the investigation can be presented:- With two-stage heating, an increase in heat transfer surface area in the domestic hot water calorifier results in greater cooling of the primary water. - Two-stage heating is more sensitive to a reduction in primary supply temperature, i.e. the primary temperature rises more than in the case of parallel conection. -The difference in primary return temperature between the two arrangements varies with radiator and domestic hot water load in a highly non-linear manner.One effect of this is that it is not possible to say categorically that lower radiator temperatures reduce the thermodynamic benefit of two-stage connection.

775 **(BFR-R—91-1987) Energy conservation town block at Kiruna.** Svarvare, K.; Hansson, S.; Roeckner, R. (B L Byggkonsult AB, Kiruna (SE); Nordprojektering Industri AB, Luleaa (SE)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 215p. (In Swedish). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88755037/JAW.

The object of this project has been to achieve the energy conservation targets recommended by the Riksdag by means of conversion, renovation and maintenance measures in existing buildings. Energy conservation measures and their profitability have been studied. The report describes the common types of measures and their implementation, and sets out the energy effectiveness and profitability of these measures. Our endeavour has been to combine proven theories and principles with actual examples in such a way that the results may be of practical utility and easy to understand. The measures carried out and studied are old established and well proven, but their results have probably not been evaluated to the same extent as in the energy conservation block. The object is thus to try to describe the experiences which may be useful in conjunction with different types of energy conservation measures, and also, at the same time, to enhance knowledge of these. (authors).

776 **(BFR-R—98-1987) Experience from a number of larger surface earth heating systems.** Sundberg, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 44p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755039/JAW.

The heat pump systems investigated in this project supply heat to the following loads: the Adult High School in Oestra Grevie, a cycle factory in Vandsbro, detached houses in Surte and detached houses in the Sandhed area of Orsa. The heat pumps in all four have operated reasonably well. As far as design is concerned the systems are of monovalent type with low-temperature heating systems. Although the Oestra Grevie installation incorporates an oil-fired boiler for supplying heat during the winter to an older part of the school, there is no load-sharing between the boiler and the heat pump. The Vansbro installation incorporates an eletric boiler, but is has not been necessary in practice to use it. As a result, the systems have not suffered from what would normally be the relatively common problems encountered in bivalent systems from joint operation. Total heat and energy demands are generally over-estimated, which has meant that heat pumps are larger than was originally intended. In purely physical terms, specific heat abstraction from the ground in kWh/m/sup 2/ per year for the various systems could be increased by 100-700%, although abstraction should also be related to the intended use of the ground. However, it is clear that it could be higher in the systems investigated here. If building these systems today, optimum system design would enable capital costs to be reduced by 10-35%. However, there does not appear to be any scope for general cost reductions per m of hose in large collector systems: the decisive factors are ground conditions and the distance between the collector and the heat pump in each individual case.

777 **(BFR-R—106-1987) Blocks of flats with glazed verandas, Taberg. Energy and indoor climate analysis.** Fredlund, B. (Lund Univ. (SE). Dept. of Building Science). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 298p. (In Swedish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88755040/JAW.

This project relates to 4 two-storey blocks of flats and associated garage buildings, store rooms and communal premises/laundry room. During design particular attention was paid to passive energy conservation measures. The field study is based on measurements in all 32 flats. An energy balance has been drawn up for an average block for the year 1982 with the aid of the BKL (Building construction) method, the input data being based on the measurements. The reduction in fabric losses from the flats due to heating of the veranda has been estimated at 4 kWh/m/sup 2/ annually. This modest saving does not on its own justify the choice of providing the flats with glazed verandas. If it is also taken into consid-

eration that the veranda construction and the glass in the veranda reduce insolation into the flat, the effect of the contribution of the veranda to the energy balance is cut by about one half, i.e. ca 2 kWh/m/sup 2/ annually. With an energy price of SEK 0.35/kWh, for a 4 room flat of ca 100 m/sup 2/ floor area, this is equivalent to an annual saving of SEK 77. During design, the airtightness of the verandas and the possibilities of utilising the energy gains from insolation were overestimated. The contribution due to heat from the occupants was underestimated. The design energy consumption for space heating is in good agreement with that obtained from an energy balance drawn up on the basis of the measurements, ca 60 kWh/m/sup 2/ annually.

778 **(BFR-R—108-1987) Influence of control strategy on heat pump operation in bivalent systems. Dynamic simulation of different control strategies.** Soensteroed, G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 40p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755041/JAW.

The main objective of this work has been to investigate how various control strategies influence the operation of a heat pump connected bivalently to an oil-fired boiler, using dynamic simulation as the working method. Computer calculations have been carried out on four design arrangements with three commonly used control strategies: 1) 'floating' condensing temperature, 2) constant condensing temperature, and 3) controlled varying condensing temperature. The results are presented in the form of tables and diagrams. The tables compare measures of efficiency. The diagrams illustrate such factors as flow and temperature durations in the radiator system, heat pump and boiler. As expected, the coefficient of performance of the heat pump is high for control strategies 1 and 3, with the heat pump operating with a low condensing temperature, and low for control strategy 2 with the heat pump being operated with a high condensing temperature. The system coefficient of performance is about the same for all operating arrangements. Heat pump availability is highest for control strategy 2. Control strategy 2 has the following advantages: 1) The various elements making up the system work together smoothly, and the heat pump operates for long periods with few starts or stops. 2) The return temperature to the boiler is high, allowing the boiler to be operated at a high temperature without detriment to heat pump operation. 3) The heat pump supplies most of the domestic hot water demand, and room temperatures are smoothly held. 4) The system is simple and easy to monitor.

779 **(CONF-881120—7) Effectiveness of thermal insulation in the attic spaces of manufactured homes.** Yarbrough, D.W.; Graves, R.S.; McElroy, D.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02. Order Number DE88016355/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

The thermal resistance of loose-fill insulations is reduced by settling that occurs after installation. The use of loose-fill insulation in manufactured homes is increasing and a need exists to evaluate the effectiveness of this application. Settling of loose- fill insulation in manufactured homes occurs during construction and over-the-road delivery. Measurements of the settling of a stabilized cellulosic insulation in four units has shown that a small amount of adhesive results in a product exhibiting 3 to 5% loss of thickness during manufacture and less than 2% additional settling during delivery. This thickness loss of about 6% is small in comparison with the unstabilized loose-fill rock wool that was observed in two units. The effectiveness of attic insulations in manufactured home units is significantly affected by the limited space available in many designs. Calculations of the thermal resistance that can be achieved in typical attics will be discussed. The results are that loose-fill materials are a better choice than batts for manufactured home attic insulation when truss design prevents complete coverage and that attic design must be improved in many cases in order to achieve specified R-values. 6 refs., 14 figs., 2 tabs.

780 **(CONF-881120—9) Testing of a Stirling cycle cooler.** Chen, F.C.; Keshock, E.G.; Murphy, R.W. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01. Order Number DE88017362/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

Stirling cycle coolers have long been used as low temperature refrigeration devices. They are relatively compact, reliable, commercially available, and use helium as the working fluid. The Stirling cycle, in principle, can be used for household refrigeration and heat pumping applications as well. Currently, these applications are almost entirely provided by the vapor compression technology using chlorofluorocarbons (CFCs) as working fluids. It has been known that CFCs cause depletion of the ozone layer that protects the earth against harmful levels of ultraviolet radiation from the sun. A recent report of a "hole" in the ozone layer above Antarctica and of possible environmental and health consequences from ozone depletion aroused public attention. The urgent need to reduce the future used of CFCs should instigate investigation of non-CFC alternative technologies. The Stirling cooler technology, which does not use CFCs, could be a viable alternative. A laboratory test of the performance of a Stirling cooler is reported and its implications for household refrigeration are explored. 11 refs., 6 figs., 2 tabs.

781 **(CONF-881120—15) Experimental study of short-tube refrigerant flow.** Mei, V.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01. Order Number DE89001493/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

Short tubes are being used for refrigerant expansion devices for their durability, ease of application, and low cost. Unlike capillary tubes, the design data for short tube are extremely rare, and yet it is widely recognized that sharp-edge orifice formula will not be adequate to predict short tube fluid flow. Correlations to size the short-tubes for air-conditioning units and heat pumps are definitely needed. Five short tubes with length-to-diameter ratios ranging from 7.5 to 11.9 were tested on a heat pump system with R-22 as the fluid. Correlations to calculate the short-tube opening size and length were formed from the test results. The correlations were used on a set of data from tests performed by other researchers. The maximum deviation of calculated short tube openings and length from measured values were 6.7% and 18%, with average deviation at 3% and 4.1%, respectively. 9 refs., 8 figs., 1 tab.

782 **(DOE/BP—990) Control home characteristics in the Residential Standards Demonstration Program: Final report.** Lou, A.T.; Thor, P.W. (USDOE Bonneville Power Administration, Portland, OR). 18 Apr 1988. 48p. NTIS, PC A04/MF A01. Order Number DE89001539/JAW.

This paper summarizes the characteristics of the thermal envelopes of 383 single-family homes built to local building practice standards over the past several years in the Pacific Northwest. It presents statistical findings on the distribution of house types; R-values for thermal insulation measures; distribution of glazing types, cardinal directions, and U-values for window glazing; and distribution and U-values for types of doors. 8 figs., 19 tabs.

783 **(DOE/BP/63401—1) High-R window technology development.** Arasteh, D.; Wolfe, J.R.; Selkowitz, S. (Bonneville Power Administration, Portland, OR (USA); Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AI79-86BP63401. 71p. NTIS, PC A04/MF A01. Order Number DE89001546/JAW.

High-R windows have several benefits, including greater energy savings, design freedom to use more and larger windows on off-south orientations, increased occupant comfort, and reduced condensation. This study (Phase 1 of a two-phase project) sought to: show that an R6-R-10 window could be built and be compatible with commercially available materials and technologies; verify predicted thermal performance values with lab and field testing; improve on existing production technologies for greater efficiency and lower cost; ascertain the structural integrity of such windows; develop first- generation prototypes; and evaluate cost-effectiveness. 21 refs.

784 **(DOE/BP/64357—1) Vacuum window glazings for energy-efficient buildings: Phase 1.** (Solar Energy Research Inst., Golden, CO (USA)). Jul 1988. Contract AI79-86BP64357. 88p. NTIS, PC A05/MF A01. Order Number DE89001544/JAW.

The primary objectives of the study were to establish a preliminary welding facility for vacuum-bonding the glass panes and to more specifically and analytically model the balance between solar gain and thermal loss for such windows in the Bonneville service area. The welding must be accomplished with enough speed and soundness to enable the windows to be built on an economically satisfactory production schedule. But the production welding of these glass sheets is basically without physical precedent, and the inclusion of the vacuum space and the low emissivity panes add elements to the development of a modeling algorithm requiring perhaps more detailed study of window conditions than ever undertaken before. 38 refs., 28 figs., 14 tabs.

785 **(EPRI-EM—6056) Economics of electric alternatives to cogeneration in commercial buildings: Final report.** Dobyns, J.; Estey, P. (Electric Power Research Inst., Palo Alto, CA (USA); Science Applications International Corp., Los Altos, CA (USA)). Oct 1988. 65p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001590/JAW.

The economics of packaged cogeneration systems are characterized for five typical commercial applications: office building with computer center, supermarket, fast food restaurant, hospital, and swimming pool/health club. The operation of these systems in each application is evaluated for three utility rate scenarios. Alternative high-efficiency electric technologies for the thermal energy application of each cogeneration package are identified, characterized, and evaluated. The economics of the packaged cogeneration systems are compared with the high-efficiency electric alternatives. 8 refs., 9 figs., 21 tabs.

786 **(FRNC-TH—3256) Chemical heat pumps used in solar cooling and solid gas systems: a microscale study of the 13X zeolite-R22 freon and barium chloride-ammonia systems.** Moutaabbid, M. (Dijon Univ., 21 (France)). 1986. 87p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755304/JAW.

After a review of the main characteristics and operating condition of the chemical heat pumps, the adsorption phenomena are studied for the following two systems: industrial zeolite 13X-freon R22 and BaCl:: (2)-NH:: (3)-BaCl:: (2), 8 NH:: (3). Thermogravimetry is used and the adsorption isotherms of the first system is determined. The formation and decomposition kinetics of the ammine BaCl:: (2), 8NH:: (3) are also determined in the temperature conditions normally encountered in solar application. The chemical heat pump efficiency is then calculated in cooling application for the two systems.

787 **(FRNC-TH—3258) Dynamic control of district heating networks.** Lidin, R. (Ecole Nationale Superieure des Mines, 75 - Paris (France)). 1986. 260p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88755303/JAW.

After a review of the different components of a district heating network (boiler plant, sub-stations, exchangers, pipes, regulation devices, ...), the various connexion schemas of these components are analysed and a transport equation for the temperature propagation in the ducts is derived (taking into account initial conditions). The transition from one duct to another is then examined. Using the developed equations and approximations, the heating network dynamical operation is optimized. Results for simple network simulations are presented.

788 (LBL—24213, pp 3.4-3.5) **California home energy rating and labeling demonstration program: what did we learn?.** Ritschard, R.; Vine, E.; Barnes, B.K.; Hsui, C.; Reyes, I. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The California Energy Commission (CEC) sponsored a demonstration program during 1985 and 1986 on rating and labeling existing homes in two California cities: Pasadena and Roseville. The goal of the project was to evaluate various delivery mechanisms that might be used in conjunction with a statewide home energy rating and labeling program. Another goal was to develop a single rating tool which could, with reasonable accuracy, rank the energy efficiency of any home within the state. First, the CEC/LBL Home Energy Rating Tool worked but it can be improved with some technical modifications and with supporting documentation. Second, comprehensive delivery systems are necessary for successful implementation of home energy rating systems (HERS). The target of home energy rating programs (homeowners or builders) must be provided with both technical and financial assistance in order to facilitate energy-deficiency improvements as well as to motivate their investment decision. Third, raters should be trained auditors with sufficient knowledge and understanding of how homeowners make decisions on improving the energy efficiency of their home. Finally, the homeowner must be viewed as an active participant in the rating process rather than as a passive recipient of a HERS label. One of the key measures of the success of a home energy rating program is how much energy is saved as a result of the homeowner's implementation of energy-saving measures. It is further recommended that a rating or certification form be provided to the homeowner as a record of the rating process.

789 (LBL—24213, pp 3.6-3.7) **Evaluation of the implementation of home energy rating systems.** Vine, E.; Barnes, B.K.; Ritschard, R. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The rating and labelling of new and existing energy-efficient homes by local, state, and federal government agencies, utility companies, and other organizations has been an activity marked by periods of intense interest and benign neglect. During the late 1970's, home energy rating systems (HERS) became important components of several energy conservation programs conducted by governmental and non-governmental organizations at national, regional, and local levels. By 1982, it seemed that the idea of a home energy rating system had become entrenched as an effective means of pursuing the goal of energy conservation. Since that time, however, a number of these systems have been abandoned, and only a few have endured. Nevertheless, a number of HERS exist, and interest in HERS has increased in selected areas of the country. In January 1986, the authors conducted a national telephone survey of home energy rating systems to examine the different kinds of HERS and implementation systems being used and to discover the range of possible implementation problems and solutions experienced by the users of these systems. Major systems were followed up in each state, and the authors examined those operated by local governments and utility companies. The authors identified 28 states willing to provide examples of some form of HERS that was currently in operation. The paper discusses HERS distribution and HERS findings.

790 (LBL—24213, pp 3.8-3.9) **Federally-assisted housing: progress and plans.** Ritschard, R.; Goldman, C.; Greely, K.; Mills, E.; Vine, E. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The US Department of Housing and Urban Development (HUD) is America's largest landlord and pays the largest residential energy bill - over $2 billion per year for all federally-assisted housing programs. 40% of low-income renters reside in public housing. Preliminary analysis of this sector indicates that a significant potential exists for improving the energy efficiency of its stock. However, these potential savings have not been fully realized for a number of reasons, such as lack of technical information on the effectiveness of various conservation measures, retrofit costs and paybacks, available financing mechanisms, and the perception that there are few incentives to conservation. In FY 1985, the US department of Energy (DOE), as part of a multifamily retrofit research program initiated an effort to improve the energy efficiency of the federally-assisted housing stock with initial emphasis on public housing. LBL, in its lead role in this sector, compiled background information on public housing buildings, their physical characteristics,

energy use patterns, conservation potential, and barriers to energy retrofit activity. From this technical background data, the authors formulated a research agenda and multiyear plan that begins to address the perceived barriers to attaining the conservation potential in public housing. Results and accomplishments to date are described.

791 (LBL—24213, pp 3.10-3.11) **Determinants of measured energy consumption in public housing.** Greely, K.M.; Mills, E.; Goldman, C.A.; Ritschard, R.L.; Jackson, M.A. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

US public housing currently shelters more than 3.5 million low-income tenants and accounts for 5.7% of the multifamily housing stock in this country. This study describes a method for analyzing housing project energy consumption that HUD can use to establish energy-use guidelines and to evaluate public housing authorities' (PHAs) operating budgets. Energy use indices such as those developed here can also help PHAs monitor their energy consumption and plan effective energy management strategies. In this study, the authors analyze energy use in 91 selected public housing projects across the US using both utility billing data and fuel oil consumption data. After adjusting annual consumption for changes in weather, they examine correlations between energy use and building and occupant characteristics, using multiple regression analysis. Energy use and costs for different subgroups of their sample (for example, high-rise and low-rise buildings) are also characterized. In addition, they compare measured energy use in public housing with engineering estimates of public housing consumption, as well as with measured consumption in privately owned multifamily buildings. This study utilizes a two-part model. In the first part, actual energy use is normalized to consumption in a year with typical weather, using the Princeton Scorekeeping Method, a widely used energy analysis model that finds weather-normalized annual consumption by regressing energy use versus degree-days calculated at the best-fit reference temperature. Then, in stage two, this normalized energy use is used to examine the influence of project characteristics on consumption levels, using multiple regression analysis. Results to date are discussed.

792 (LBL—24213, pp 3.12-3.13) **Computer-generated residential building loads data bases.** Huang, J.; Bull, J.; Ritschard, R. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

Large computer models for detailed building energy simulation such as DOE-2 are very useful for calculating the energy saving potential of various building conservation measures through repetitive simulations under consistent operating and climatic conditions. The resultant data base can be applied to the development of energy conservation standards, design guidelines, or simplified analysis tools. Over the past decade, the Building Energy Analysis Group has conducted extensive computer analysis of the impact of conservation measures on residential energy use in different US locations. From 1982 to 1986, the authors compiled a large data base of residential energy use using the DOE-2.1A and DOE 2.1B programs. The technical documentation for this effort is in a LBL report, while the data has been incorporated into the PEAR (Program for Energy Analysis of Residences) microcomputer computer program. In 1987, the authors were asked by Pacific Northwest Laboratories (PNL) to create a new version of this data base for a microcomputer-based residential energy standard PNL was developing in conjunction with ASHRAE, with support from DOE. The authors substantially reduced the effort required for this task by utilizing regression techniques developed from their earlier work. This allowed them to produce a data base that was compact, analytical, and flexible. Although the data base is presented in various ways, the primary output are sets of regression equations that comprise a simplified technique to estimate energy use in typical houses of varying sizes, shapes, and conservation levels.

793 (LBL—24213, pp 3.14-3.15) **Conservation potential of foundation insulation measures.** Huang, J.; Bull, J. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

In the last decade, there have been significant improvements in the thermal integrity of new houses through increased use of ceiling and wall insulation, multiple-pane windows, and reduced infiltration. Current buildings practices, however, often ignore foundation insulation because of uncertainty about their potential benefits. Although measured data have indicated that the conservation benefits may be large, there is need for a systematic study of the thermal performance of different foundation options. In FY 1987, the Building Energy Analysis Group worked on a DOE-funded project headed by the Underground Space Center (USC) at the University of Minnesota to develop a handbook on energy-efficient building foundation design. The purpose of the handbook is to provide design guidance to architects and designers on residential foundations with emphasis on energy and structural issues. LBL's role in the project was to develop with the USC a procedure for simulating the energy uses of a typical residential building with nearly 90 different foundation conditions for 13 US locations. Work to date is described.

794 (LBL—24213, pp 3.17-3.18) **Updated compilation of measured energy savings in retrofitted multifamily buildings.** Goldman, C.A.; Greely, K.M. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The multifamily sector, consisting of residential building with two or more units, comprises almost 27% of the US housing stock (in terms of household units). Annual site energy use in these buildings is approximately 2.3 quads (1 quad = 10^{15} Btu) and directly or indirectly costs US households almost $20 billion. The authors have compiled and analyzed measured data on 200 US retrofit projects in existing multifamily buildings that are now part of the Buildings Energy Use Compilation and Analysis (BECA) residential data base. They examined the costs of conservation measures and practices and the savings they generate. In this article, the authors also discuss the cost-effectiveness of different retrofit strategies in fuel and electrically heated buildings.

795 (LBL—24213, pp 3.19-3.20) **Incremental value of measured data from the residential standards demonstration program.** Meier, A.; Nordman, B. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

In an attempt to reduce future electricity needs, the Bonneville Power Administration (BPA) proposed to implement stringent efficiency electricity standards for new, electrically heated houses. BPA first sought to determine the potential energy savings for houses built to the Model Conservation Standards (MCS) through a major monitoring program. The Residential Standards Demonstration Program (RSDP) sponsored the construction of over 300 houses built to the MCS and selected over 300 recently-built houses to serve as controls. BPA asked LBL to estimate the actual energy savings from the MCS. A simple comparison of energy use was not possible because the houses differed greatly in their design and operation. Moreover, BPA sought to determine the energy savings under normal conditions to permit comparisons with its simulations of prototype houses. The authors applied techniques developed to support their compilation of new, low-energy homes (BECA-A) to analyze the savings. In particular, the program, SUBMET, normalizes metered space heating energy for differences in floor area, internal gains, inside temperatures, and climate. The authors relied on weekly energy and temperature data from the triple-meters (which monitored space heating, water heating, and appliances) and temperature loggers. They also drew upon surveys and audits to provide floor areas and occupancy data.

796 (LBL—24213, pp 3.20-3.22) **Analysis of utility program experience: preliminary results from the MEOS study.** Krause, F. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The Building Energy Data Group has been expanding its work on technology cost and performance assessments to include experience with utility incentives programs to promote customer efficiency investments and participation in load management. A preliminary analysis of several appliance, lighting efficiency, and load management programs in the residential sector was performed as part of LBL's contribution to the Michigan Electricity Options Study (MEOS). It is widely recognized that the implicit economic decision-making in the purchase of energy-consuming devices by energy consumers does not follow lines of least-cost rationality. One objective of the MEOS demand-side analyses was to define the amount of energy and peak demand savings that could be realistically obtained from the technologies considered, if utilities were to aggressively pursue specific incentive programs to shift the purchasing behavior of their customers. This requires incorporation of achievable annual participation rates and cumulative penetration fractions into the analysis. Also, the administration and incentives cost of such programs must be ascertained. Such an analysis is presently difficult because only a limited number of programs have been carefully monitored over an extended period of time, and even fewer programs have been aggressively pursued. LBL's method was to assume that aggressive programs would provide incentives in such a way as to eliminate all extra first costs for participants (full incentives). Results to date are discussed.

797 (LBL—24213, pp 3.22-3.24) **Technology assessment: cool storage in commercial buildings.** Piette, M.A.; Wyatt, E. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The authors studied the current status and future potential of commercial cool storage. There is clearly no single best system because the parameters, i.e., building type, load profile, status of existing equipment (if a retrofit or addition), first costs (considering any utility incentives or tax incentives), and electricity rate structures, strongly influence the design. Research and development is underway on more efficient refrigeration systems, ice building and storage techniques, and advanced phase change materials. Until recently cool storage has been used mainly in larger buildings with central chilled water systems. Now, a few manufacturers are offering packaged unitary roof top air conditioning units with ice storage. It is estimated that package units represent nearly three-fourths of the installed capacity for 1985. Determining the cost-effectiveness of a cool storage system requires a comparison with a base case cooling system. Most cool storage systems are more expensive than conventional HVAC systems. The base case for an existing building is usually the pre-retrofit conditions. The most precise performance comparisons are based on actual metering of cooling loads. Measured cooling loads can then be used to calculate how a conventional system would perform under the same conditions that the cool storage system operated. Use of measured data accounts for the differences in weather and occupancy that occur between actual and simulated (or design) conditions.

798 (LBL—24213, pp 3.24-3.26) **Strategies for reducing urban summer heat islands.** Akbari, H.; Huang, J.; Rosenfeld, A. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The urban heat island results from the interaction of many factors, such as increases in the surface roughness and anthropogenic heat release from buildings and vehicles, coupled with decreases in the urban albedo and decreases in the evaporation rate which follow as trees and vegetation are replaced by impervious building materials. While some planners have regarded urban heat islands as inevitable products of urbanization, others have speculated that they could be alleviated by adding vegetative cover, spraying water on building tops, increasing the number of fountains and pools, choosing light colors for building exteriors, avoiding the use of dark-colored asphalt and bitumen in streets, altering urban dimensions, or minimizing the anthropogenic heat release rate. The objective of the heat research at Lawrence Berkeley Laboratory is to quantify the energy saving potentials of such urban conservation strategies by developing and applying analytical models to simulate urban microclimates and the cooling energy requirements for buildings located within them. The results can be used to identify the most cost-effective methods for mitigating the urban heat island and to develop guidelines and suggestions for city planners, landscape architects, and architects. The authors have developed preliminary numerical models to simulate the effects on urban microclimates from changes in the amount of urban vegetation and the magnitude of urban albedo. Assuming that the changes are implemented city-wide, these models predict significant energy savings. They have also begun addressing the constraints and possible conflicts that may arise in the implementation of such city-wide energy conservation measures.

799 (LBL—24213, pp 3.27-3.28) **Analysis of whole-building short-interval electric load data.** Akbari, H.; Heinemeier, K.; LeConiac, P.; Flora, D. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

As part of a statewide program, California utilities have collected 15-minute interval load research data for commercial buildings with time-of-use rate schedules and a connected load exceeding 500 kW. Some utilities have also conducted energy audits of commercial buildings as part of a survey of California's building stock. These databases provide valuable sources of measured information for analysis of energy use in California commercial buildings. The building characteristics, occupancy, and actual operation combine to create a unique demand signature in the building's load shapes. Some quantitative insights can be extracted from the 15-minute load data through a series of detailed analyses of temperature response, annual load-shape, frequency of equipment use, and comparisons of building load profile on the building's peak day with its profile on the utility's peak day. While these analyses are by no means exhaustive, they form a basis for understanding the individual end uses of energy in commercial buildings without specifically monitoring them.

800 (LBL—24213, pp 3.30-3.31) **Energy conservation policy for commercial buildings in Southeast Asia.** Levine, M.D.; Akbari, H.; Busch, J.; Byrne, S.; Deringer, J.J.; Olson, K.H.; Turiel, I.; Warren, M. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The overall purpose of this project is to stimulate the development and implementation of policies to increase the efficiency of energy use in commercial buildings in five countries in the Association of South East Asian Nations (ASEAN): (1) Indonesia, (2) Malaysia, (3) Philippines, (4) Singapore, and (5) Thailand. This is carried out through training, research projects, analysis and assessment, and information dissemination. Previous research demonstrated that significant energy savings in commercial buildings are possible. The types of measures that can reduce energy costs and the magnitude of savings that can be achieved are shown in a figure. The largest reductions in energy use are for windows and lighting measures and that the overall reductions are substantial (more than 20% for daylighting alone). These large savings are particularly impressive when one recognizes that Singapore, for which the analysis was performed, already has among the most energy efficient buildings of any place in the tropics, having instituted an energy conservation standard in 1979 and having now achieved full compliance with the standard. For the ASEAN region as a whole, 20% savings (achievable in a ten-year time frame with a payback of two to four years) represents an annual electricity savings of about $400 million. (More than one-third of the electricity used in the region is in commercial buildings.)

801 (LBL—24213, pp 3.31-3.34) **Analysis of federal appliance efficiency standards.** Ruderman, H.; Chan, P.; Cunliffe, P.; Heydari, A.; Koomey, J.; Levine, M.D.; McMahon, J.E.; Springer, T.; Stoft, S.; Turiel, I.; Wood, D. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

LBL is responsible for an integrated analysis of the impacts of federal appliance efficiency standards. The research involves a detailed assessment of the impacts on consumers, manufacturers, electric utilities, and on the nation as a whole. The analysis is carried out in four major tasks: (1) an Engineering Analysis to quantify the efficiency improvements of various design options and their costs; (2) a Consumer Analysis to project the energy use, shipments, purchase price, and operating costs of more efficient products; (3) a Manufacturer Analysis to determine impacts on the appliance manufacturing industry; and (4) an Impact Analysis to examine the impacts of standards on various groups. The latter includes changes in consumer life-cycle costs, competition within the manufacturing industry, fuel savings and reduced need for new generating capacity by electric utilities, an assessment of environmental impacts, energy savings by fuel type, and the net present benefit of standards to the nation.

802 (LBL—24213, pp 3.34-3.35) **LBL residential energy model.** McMahon, J.E.; Chan, P. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

Detailed forecasting models have been used since the mid-1970s to assess potential impacts on consumers of proposed federal energy conservation policies. The first such model intended as a policy analysis tool for the residential sector was the Oak Ridge National Laboratory (ORNL) Engineering-Economic Model of Residential Energy Use. A version of the ORNL Model was moved to LBL and adapted for an analysis of Consumer Product Efficiency Standards in 1979. Public comments during the rulemaking process and new analyses at LBL have suggested many changes in the methodology for simulating residential energy consumption. The accumulation of major changes to the method, including a new analysis of fuel and technology choice for space heating and cooling in new buildings, makes the LBL version of the ORNL model unique. The increasing availability of data and the need to analyze issues raised by interested parties in the rulemaking process have driven the transition from the ORNL to the LBL Model. The major methodological differences include: representation of recent equipment efficiency trends, forecasting of future appliance efficiencies based on an analysis of market behavior during the last decade; calculation of appliance replacements based on historical purchases and retirements; the data base for equipment costs and efficiencies; and treatment of competitive space conditioning systems (including heat pumps and small-capacity gas furnaces). In addition, the LBL Model has been integrated with other tools for the study of individual electric utilities. A recent description of the current model, including changes to the original ORNL Model, is available. Modifications accomplished in FY 1987 are described.

803 (LBL—24213, pp 3.36-3.37) **Analyses of energy intensities and load shapes.** Ruderman, H.; Turiel, I.; Eto, J.H.; Heinemeier, K.E. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The California Energy Commission (CEC) every 2 years prepares forecasts of electricity demand and peak loads in the state. The CEC now wants to improve the data used in their forecasting models for the 1989 Electricity Report. They have contracted with LBL through the U.C. University-Wide Energy Research Group to provide data on (1) commercial sector end use intensities and (2) residential end-use load shapes for use in their models. The first phase of this project will provide a detailed comparison of the definitions and analytical methods used to generate commercial end-use energy utilization intensities (EUIs), recommendations for resolving differences, and a list of topics requiring additional data collection or research. Where data are available, EUI estimates will be compared to actual metered data, and needs for further end-use monitoring identified. The second phase will consist of a pilot project with Southern California Edison (SCE), for which EUIs will be calculated using on-site survey data, 15-minute interval whole-building load research data, and the DOE-2 Building Simulation Model. The purpose of this part of the project is to analyze available metered data on end-use load shapes to refine the current estimates used in the CEC peak demand models. The 17 end-use load shapes currently in the CEC Residential Peak Load Model will be compared to monitored data collected by California utilities and out-of-state sources. The project will also assist the Commission staff in laying the groundwork for transforming the peak demand models into models that forecast hourly loads throughout the year, based on LBL's experience in constructing and validating its Residential Hourly and Peak Load Model.

804 (LBL—24213, pp 3.38-3.39) **Least-cost planning for the Pacific Gas and Electric Company.** Kahn, E.; Pignone, C.; Comnes, G.A. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

The goal of this project is to develop methods for evaluating demand-size programs explicitly within the context of the traditional electric utility resource planning process, an approach that is generally known nowadays as least-cost planning (LCP). The project is designed as a study of the Pacific Gas and Electric Company (PG & E) and is partially funded by the company. The analysis is based on the use of an Electric Power Research Institute integrated utility planning model, the Load Management Strategy Testing Model (LMSTM), for production costing and forecasting, the DOE-2.1 building energy simulation model, for demand-side effect estimation, the LBL Residential Energy Model (LBL-REM) for electrical load forecasts, and locally written software for program evaluation and cost benefit analysis. Following the completion of the calibration of LMSTM to the detailed production costing models used at PG & E, a LCP exercise based on large-scale implementation of two demand-side programs was carried out through several time horizons. The first test case is a somewhat hypothetical one that estimates the consequences of widespread adoption of the emerging thermal energy storage (TES) technology in commercial buildings. The second program (RAC) draws on past LBL work and involves the implementation of an efficiency standard for new residential room air conditioners, central air conditioners, and heat pumps installed in the PG & E territory.

805 **(LBL—25665) Shelter and indoor air in the twenty-first century: Radon, smoking and lung cancer risks.** Fabrikant, J.I. (Lawrence Berkeley Lab., CA (USA)). Apr 1988. Contract AC03-76SF00098. 16p. (CONF-8804205—1). NTIS, PC A03/MF A01. Order Number DE89000549/JAW.

From Conference on environmental health in the 21st century; Research Triangle Park, NC, USA (5 Apr 1988).

This document describes the relationship between indoor radon exposure, cigarette smoking, and lung cancer. The author explains the sources of radon, the tissues at risk, the human populations most likely to be affected, and the estimates of lung cancer in the population. 6 refs., 2 tabs. (TEM)

806 **(NEI-DK—99) Thermal blinds.** Lund Nielsen, B. (Jysk Teknologisk, Aarhus (Denmark). Byggeteknik). Sep 1987. 70p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755052/JAW.

A method of reducing heat losses through windows, by covering them with insulating blinds, is presented. Extensive testing was carried out in order to investigate the thermal insulation properties of several commercially produced insulating blinds, and the risk of moisture condensation occurring on the window surfaces, and of too high indoor temperatures resulting, was estimated. The blinds that insulated most efficiently were found to reduce the heat loss by approximately 60%. Condensation was observed only when outside temperatures were exceptionally low. Insulating strips attached around the edges of the windows reduced the heat loss by about 12.5%. The indoor temperature was increased very considerably when the sun shone on the windows, but there seemed to be little risk of this causing damage to the window glass. (AB).

807 **(NP—9770089) Use of transparent thermal insulation in old buildings, taking into account architectural and energy aspects.** Munding, M. (Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.). Bereich Waerme/Klima; Stuttgart Univ. (Germany, F.R.)). 1987. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE89770089/JAW.

Initiatives to make notable cuts in energy consumption have to start with energy-wise modernisation of old buildings. By using transparent thermal insulation systems, great successes can be achieved. A richly illustrated overview of this problem complex first gas into the significance of thermal insulation in building construction. Details concern conventional thermal insulation works and its structure, with remarks on the influence of thermal insulation properties, climate, wall building material, orientation, wall structure and sunscreening. The author then goes on to discuss transparent thermal insulation in old buildings. The subjects treated are: selection of building, surfaces suitable for transparent insulation in old buildings, an architectural application study (size of insulating elements, influence of frame segments), the consequences to be drawn from this study, and the energy-wise effects of various types of insulating measures. The annual cut in heating energy consumption that can be made by opaque insulation amount to between 35 and 60%, and by transparent insulation between 28 and 46%. (HWJ).

808 **(ORNL/M—592) Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer progress report for DOE Office of Buildings and Community Systems: Monthly progress report.** Samples, S.D.; Coleman, G.L. (comps.). (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 48p. NTIS, PC A03/MF A01. Order Number DE89001326/JAW.

The Monthly Report of the Building Thermal Envelope Systems and Materials (BTESM) Program is a monthly update of both in-house ORNL projects and subcontract activities in the research areas of building materials, wall systems, foundations, roofs, building diagnostics, and research utilization and technology transfer. Presentations are not stand-alone paragraphs every month. Their principal values are the short-time lapse between accomplishment and reporting and their evolution over a period of several months.

809 **(ORNL/Sub—81-7762/6-01) Measurements of heat-transfer coefficients of nonazeotropic refrigerant mixtures condensing inside horizontal tubes.** DeGrush, D.; Stoecker, W.F. (Oak Ridge National Lab., TN (USA); Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). Nov 1987. Contract AC05-84OR21400. 129p. NTIS, PC A07/MF A01. Order Number DE89001310/JAW.

Some preliminary observations from previous system tests on a refrigeration facility using a mixture of R-12/R-114 indicated a reduction in condensing heat-transfer coefficients with the mixture in comparison to either constituent operating alone. Further exploration of this phenomenon involved a glass tube condenser constructed previously for observation of the flow regimes during the condensation process. The study, which is documented by this report, was pursed still further with a copper-tube condenser constructed only for the purpose of measuring heat-transfer coefficients and correlating them with the flow regimes previous observed. In tests that duplicated the flow regimes of the earlier work, the previous results were confirmed in that a low heat-transfer coefficient prevails in the early stage of the condenser, for both a single refrigerant and a mixture. It is in the midrange of the condenser that the mixture experiences its greatest reduction in coefficient in comparison to either constituent. Stratified flow prevails in the midrange of the condenser, so that liquid/vapor slip, if it does occur, would be most prominent in this section. Attempts to measure liquid and vapor concentrations to establish the existence of slip were not successful. From an application standpoint, heat-transfer enhancers such as turbulence promoters should be considered for this midsection of the condenser. 27 refs., 79 figs.

810 **(PB—88-234786/XAB) Controls for heating, ventilating, and air-conditioning systems. Final report.** (National Research Council, Washington, DC (USA). Building Research Board). Jul 1988. 70p. NTIS, PC A04/MF A01.

During the past 15 years federal agencies have experienced numerous problems with controls for heating, ventilating, and air-conditioning (HVAC) systems. As a result, federal agencies have taken or are considering a variety of actions to minimize problems. The Federal Construction Council asked the Building Research Board to assemble a committee to review the situation and make appropriate recommendations. This committees report reviews the current state of the art in HVAC controls, critiques the various actions that federal agencies have taken or plan to take, and proposes additional remedies for the consideration of the agencies.

811 **(PIRSEM—1078) Heat transfer at the porous medium-fluid medium interface. Application to dynamic isolation.** Caltagirone, J.P. (Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM)). 1987. 51p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755310/JAW.

In the field of permeodynamic isolation and its applications to residential insulation, a theoretical and experimental study has been conducted on vertical cavities divided by a porous layer and especially the influence of various parameters on the evolution of the heat transfers. It appears that, when the height of the cavity and the thermal stress are sufficiently large, on active fluid circulation through the porous layer exists which stimulates the heat transfer and thus decreases the insulation properties. Simulations and experimental verifications are presented. Results are rather insatisfactory.

812 **(PNL—6571) Estimating the market penetration of residential cool storage technology using economic cost modeling.** Weijo, R.O.; Brown, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 47p. NTIS, PC A03/MF A01. Order Number DE89002081/JAW.

This study estimated the market penetration for residential cool storage technology by using economic cost modeling. Residential cool storage units produce and store chill during off-peak periods of the day to be used during times of peak power needs. The report provides projections of unit sales expected in 5-year intervals for the years 1995, 2000, 2005, and 2010. Such projections help to determine the maximum amount of energy that could be displaced by this technology in the future. 19 refs., 4 figs., 10 tabs.

813 **(PNL-SA—14683) Large-scale field measurements of electrical energy consumption.** Hauser, S.G.; Crowder, R.S. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 10p. (CONF-870902—3). NTIS, PC A02/MF A01. Order Number DE89001512/JAW.

From ICBEM '87: international congress on building energy management; Lausanne, Switzerland (28 Sep 1987).

A computerized central data acquisition system was designed to measure the electricity consumption of both residential and commercial buildings. The system records hourly electricity use for up to 22 separate end-uses, and automatically stores the data in a central archive for easy access to analysts. The system is currently collecting data from 450 residences and 150 commercial buildings spread geographically throughout the states of Washington, Oregon, Idaho, and Montana. With over one year's worth of data for each site, the data are being used to address many issues relating to energy conservation and load management. 9 refs., 5 figs.

814 **(PNL-SA—15587) Thermal characterization based on high time resolution end-use metered data.** Pearson, E.W.; Stokes, G.M.; Miller, N.E. (Pacific Northwest Lab., Richland, WA (USA)). 28 Jun 1988. Contract AC06-76RL01830;AI79-83BP13795. 12p. (CONF-880814—10). NTIS, PC A03/MF A01. Order Number DE88015931/JAW.

From Summer study on energy efficiency in buildings; Pacific Grove, CA, USA (28 Aug 1988).

High time resolution electrical end-use data, along with supporting weather and characteristics information, is becoming available from several major metering projects. We have developed a general approach to characterization of residential thermal performance based on such data. Our approach provides: Estimates of total annual heating loads under standardized conditions; Estimates of the impact of wood heat, temperature control strategy, and other occupant-controlled factors on heating load; and Detailed insight into the factors that control heating requirements on a daily basis in single residences or groups of homes. We begin by deriving a nonparametric relationship between space heating requirements and inside-outside temperature difference from data aggregated to the daily level. The statistical method used is resistant to outliers. Data that is contaminated by wood heat use, or is not reflective of normal occupancy patterns are excluded prior to the fitting process. The resulting model can be used with a reference set of temperature data to derive a standardized measure of annual space heating load. Simple adjustments can be used to permit comparison of homes operated using different control strategies. Because no linear model is imposed, the method can be used for data which does not display an approximate linear relationship between heating load and temperature. 9 refs., 6 figs.

815 **(PNL-SA—15598) Adjustment of residential heating loads predicted by degree day models across climate zones in the Pacific Northwest.** Conner, C.C.; Lucas, R.G. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 15p. (CONF-880814—15). NTIS, PC A03/MF A01. Order Number DE88015935/JAW.

From Summer study on energy efficiency in buildings; Pacific Grove, CA, USA (28 Aug 1988).

Heating-degree-day-based prediction models such as PRISM are a simple and common method of calculating heating loads for residential buildings. Implicitly assumed in these models is that the UA and temperature are the only driving variables. However, climate variables such as solar grains and daily temperature swing also have an effect on heating loads. These variables will not be correctly accounted for when predicted heating loads for one climate are based on measured data for a different climate if only heating degree days are used. This paper examines the correlation of outdoor temperature with various climate variables. Synthetic data produced from the SUNCODE simulation model have been used for this analysis. Four Northwest locations have been studied and simulated to cover a wide range of building UAs and solar gains. A systematic bias is demonstrated in the correlation of temperature with solar gains. Results indicate that heating-degree-day-based methods using data from milder climates overpredict the milder climates. Significantly more accurate predictions are obtained when climate parameters in addition to the heating degree days are accounted for. 12 refs., 8 figs., 2 tabs.

816 **(PNL-SA—15605) Advanced energy design and operation technologies.** Brambley, M.R.; Crawley, D.B. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 6p. (CONF-880814—17). NTIS, PC A02/MF A01. Order Number DE89001249/JAW.

From Summer study on energy efficiency in buildings; Pacific Grove, CA, USA (28 Aug 1988).

Current practice in design of commercial buildings does not adequately consider the relationships between design decisions and energy performance. Estimates indicate that if energy criteria were integral to the design process, more than 15% of the energy used in new buildings could be conserved. This could be done using readily available energy-efficient design knowledge, without any increase in first costs. Furthermore, building design necessarily involves assumptions concerning use and operation of the building once it is built. Currently, operations practices intended by the designer are not adequately transferred during commissioning to building operators for use as guides during operation. Advanced technologies for overcoming these problems are described in this paper. The advanced energy design and operations technologies will consist of an intelligent automated design advisor that utilizes artificial intelligence and other advanced computer technologies to provide assistance to and encourage interaction among all participants in the design process. Assistance will be provided at all points in the building design process, especially in the early phases of design (e.g., during building programming) where decisions can have particularly significant impacts on energy consumption. The technology used for the design advisor will facilitate transfer of critical operation guidance to building operators and, coupled with monitoring technology, provide feedback on performance to the design process. 4 refs., 1 fig.

817 **(PNL-SA—15650) Evaluating and monitoring energy conservation in multi-building clusters with statistical models.** Darwin, R.F.; Mazzucchi, R.P. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 8p. (CONF-8809103—6). NTIS, PC A02/MF A01. Order Number DE89001739/JAW.

From 5. annual symposium on improving building energy efficiency in hot and humid climates; Houston, TX, USA (13 Sep 1988).

A standardized method for modeling energy consumption in mixed clusters of residential and commercial buildings is described. The basic approach is to delineate energy consumption along three dimensions: time, day-length, and temperature. The temperature-sensitive portion of energy consumption is captured by the Princeton Scorekeeping Method (PRISM). The time- and daylength-sensitive portions of energy consumption are captured by other variables. The models were designed to aid in determining the scope and performance of alternative financing activities on a US Army base. 2 refs., 6 figs., 1 tab.

818 **(PNL-SA—15968) Development of recommendations for the Department of Energy's voluntary residential energy standard.** Taylor, Z.T. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 14p. (CONF-881033—3). NTIS, PC A03/MF A01. Order Number DE89001992/JAW.

From International congress on technology and technology exchange; Pittsburgh, PA, USA (18 Oct 1988).

Pacific Northwest Laboratory solicited representatives of building industries and state and local code enforcement bodies to assist in the development of residential energy conservation standards for the US Department of Energy. The resulting standards provide a unique means of transferring energy cost-effectiveness information to states and localities. 5 refs.

819 **(SVF—296) Competitive capacity of absorption heat pumps.** Dahlen, G.; Nordling, J. (Aaf, Energikonsult, Stockholm (Sweden)). (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Mar 1988. 59p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755112/JAW.

The report is on absorption heat pumps of type I and briefly an outline on type II, i e heat transformers. Moreover, a description of the two alternatives electric compressor heat pump and steam jet heat pumps and a technical and a financial comparison between the absorption heat pump and the above two alternatives. As an introduction there is a survey of typical heat factors and limited temperature intervals of the different alternatives. Diagrams show the energy costs and the heat costs including the capital. A number of parameters are also accepted in the form of typical values. The requirements for the absorption heat pump technique regarding the Swedish conditions can be concluded in the two points stated below. 1. From a general point of view the absorption heat pumps cannot compete with electrical operating compressor heat pumps. However, the circumstances might change on the assumption that the price of electricity increases by more than 50% compared to today's level. 2. Conceivable applications in systems at very low prices are: - Up-grading of industrial waste heat with hot water or low pressure steam, which are produced by cheap internal energy sources (fuels) where the waste heat does not have any value at all. - Heat recovery in flue gases from combustion of, say, humid biofuels, where the produced hot water or steam are operating energy sources. - Applications where certain environmental advantages can be produced at the same time as heat is recovered, say flue gas condensing at waste combustion. (authors).

820 **High-performance buildings.** Krebs, M. (Lawrence Berkeley Lab., Berkeley, CA (US)). *Mechanical Engineering;* **110**: No. 9, 56-61(Sep 1988).

Research conducted at federal laboratories working with industrial firms has brought about improvements on the management of energy systems. Leading the effort to improve building energy efficiency are the Lawrence Berkeley Laboratory, Oak Ridge National Laboratory and the National Bureau of Standards. In this article, the author describes some of the advances made in lighting, window coatings, roofing and heat pumps.

821 **Measurement of fenestration net energy performance: Considerations leading to development of a Mobile Window Thermal Test (MoWitt) facility.** Klems, J.H. (Applied Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). *Journal of Solar Energy Engineering;* **110**: No. N-3, 208-216(Aug 1988).

The authors present a detailed consideration of the energy flows entering a building space and the effect of random measurement errors on determining fenestration performance. Estimates of error magnitudes are made for a passive test cell; they show that a more accurate test facility is needed for reliable measurements on fenestration systems with thermal resistance 2-10 times that of single glazing or with shading coefficients less than 0.7. A test facility of this type, built at Lawrence Berkeley Laboratory, is described. The effect of random errors in this facility is discussed and computer calculations of its performance are presented. The discussion shows that, for any measurement facility, random errors are most serious in nighttime measurements, and systematic errors are most important in daytime measurements. It is concluded that, for this facility, errors from both sources should be small.

3202 Transportation

REFER ALSO TO CITATION(S) 81, 81, 712, 1181

822 **(AFME—82-ET-170) Energy conservation and labour employment in the road transport domain.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 106p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88754976/JAW.

A study concerning the effects of energy conservation research and systems in the automobile domain on the national employment rate is presented. It is shown that many employments and jobs could be created through the development of conservation automatic systems for cars and trucks, and through the formation and training of employees (garage, car-sellers, etc.) and drivers on the energy conservation themes. A prospective energy conservation policy is proposed and its influence on employment is discussed.

823 **(DOE/MC/23168—2541) Advanced coal fueled gas turbine system definition: Topical report.** James, A.M.; Horner, M.W. (General Electric Co., Cincinnati, OH (USA)). Feb 1987. Contract AC21-86MC23168. 326p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88001038/JAW.

The coal-fired gas turbine system definition and economic assessments are based on the Coal Burning Locomotive Study previously conducted by the GE Transportation Systems Business Operations with Burlington Northern and Norfolk Southern railroad sponsorship, and later with additional funding from the United States Department of Energy. The objectives of that study were to validate the feasibility of locomotive designs using coal as a fuel substitute for diesel oil. The objective of this report is to provide a preliminary definition of a coal fueled gas turbine locomotive system and a preliminary assessment of the system technical merits and economic boundaries. The system definition will be used to guide the technology development efforts in the Advanced Coal Fueled Gas Turbine System Program. The overall program objective is to develop the technological basis necessary for subsequent commercial development of direct coal fueled gas turbine power systems. The system definition will be updated as the technological bases mature through program component development and integrated system testing.

824 **(DOE/OR/21400—HO) Light duty truck fuel economy: Review and projections, 1980--1995: Final report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Nov 1988. Contract AC05-84OR21400. 89p. NTIS, PC A05/MF A01. Order Number DE89001790/JAW.

In this analysis, historical trends in sales and fuel economy of light-duty trucks were reviewed for the 1980--1986 period, and projections for the 1987-1995 period were derived. 1 fig., 26 tabs.

825 **(N—88-24641) NASA/industry advanced turboprop technology program.** Ziemianski, J.A.; Whitlow, J.B. Jr. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 26p. (NASA-TM—100929; E—4198; NAS—1.15:100929; CONF-8808144—). NTIS, PC A03/MF A01.

From 16. congress of the International Council of the Aeronautical Sciences; Jerusalem, Israel (28 Aug 1988).

Experimental and analytical effort shows that use of advanced turboprop (propfan) propulsion instead of conventional turbofans in the older narrow-body airline fleet could reduce fuel consumption for this type of aircraft by up to 50 percent. The NASA Advanced Turboprop (ATP) program was formulated to address the key technologies required for these thin, swept-blade propeller concepts. A NASA, industry, and university team was assembled to develop and validate applicable design codes and prove by ground and flight test the viability of these propeller concepts. Some of the history of the ATP project, an overview of some of the issues, and a summary of the technology developed to make advanced propellers viable in the high-subsonic cruise speed application are presented. The ATP program was awarded the prestigious Robert J. Collier Trophy for the greatest achievement in aeronautics and astronautics in America in 1987.

826 **(PB—88-234810/XAB) Auto occupancy monitoring. Final report, January 1987-October 1987.** Ulberg, C.; McCormack, E. (Washington State Transportation Center, Seattle (USA)). Jun 1988. 32p. NTIS, PC A03/MF A01.

There are only limited opportunities to add significantly to the transportation infrastructure in the Puget Sound region in the next 15 to 20 years. For this reason, there is a growing interest in improving the efficiency of the existing system. One way to do this is to increase the average vehicle occupancy (AVO) on freeways and arterials. Programs to accomplish this must be capable of evaluation. Therefore, accurate and up-to-date information on AVO is required. The research project investigated various methods to measure AVO in order to determine the feasibility and costs of a continuous, ongoing data-collection program. Since it was determined that there are no promising approaches using automatic methods employing new technology, the study focused on the use of human observers. The degree of accuracy was studied using three observers counting the occupancy of the same vehicles at the same time.

827 **(PB—88-235247/XAB) Recycling seal-coat pavements with self-cementing fly ash. Phase 1 final report.** Ferguson, E.G. (Terracon Consultants, Lenexa, KS (USA)). Aug 1985. 28p. NTIS, PC A03/MF A01.

See also PB—87-232898.

It is proposed that existing pavements can be pulverized in place, sufficient quantities of Class C fly ash and water added, and the resulting mixture compacted to produce a stabilized pavement base section. A laboratory study was conducted to evaluate the degree of stabilization that could be attained and the physical factors influencing the degree of stabilization. Amount and maximum diameter of hydrocarbon-bound particles, gradation of mineral aggregate, fly-ash content and use of a retarder were studied. The laboratory study was supplemented by information obtained from construction of a field-test section. Influence of the self-cementing fly ash on the recycled mixtures was evaluated on the basis of compressive strength, CBR and durability as evaluated by vacuum saturation in accordance with ASTM C-593. The study indicates that the proposed recycling procedure is both technically and economically feasible.

828 **(PB—88-235957/XAB) Handbook for increasing competition in public transportation by recognizing and dealing effectively with labor requirements.** Barnum, D.T. (Illinois Univ., Chicago (USA)). Feb 1988. 53p. NTIS, PC A04/MF A01.

The handbook identifies the labor issues most frequently encountered in an effort to increase competition and suggests methods for dealing with them. Its purpose is to assist local decision makers to clearly understand what labor requirements face their agency, carefully plan their future course of action, and resolutely continue the commitment to increasing competition. Part I of the handbook introduces the various types of labor requirements imposed on attempts to increase competition in transit. Part 2 discusses the requirements from collective bargaining agreements, and Part 3 examines the requirements from Section 13(c) of the Urban Mass Transportation Act of 1964 as amended. Part 4 of the document discusses some general conclusions about the influence of labor requirements on attempts to increase subcontracting and contracting for service.

829 **(PB—88-236575/XAB) Privatization of public transit. Final report.** Morlok, E.K.; Harker, P.T.; Ellerman, D.R.; Moseley, F.A.; Choi, S.C. (Pennsylvania Univ., Philadelphia (USA)). May 1988. 96p. NTIS, PC A05/MF A01.

This research investigated two important issues in the drive to control transit costs and provide transit service that is more responsive to urban travel needs. One study investigated the problem of how to construct federal incentives to induce greater use of competitive contracting in transit operations. Prior research has revealed that cost savings in the range of 20 to 40% are possible from contracting in larger metropolitan areas, but very few transit systems have chosen to begin contracting service. This study examined various federal policy options and used a combination of theoretical analysis and interviews with transit executives and others to identify changes in subsidy and capital grant programs that will induce greater use of contracting. The second study examined the effect of allowing private operators to freely enter the transit market, a policy which is essentially untried in the U.S. Using Philadelphia as an example, results indicate that where subsidized public operations continued, private operations would focus on markets that were not well served by the public operator and markets where traffic is dense.

830 **(PB—88-237367/XAB) Private-sector contracting for transit services: operator handbook.** (International Taxicab Association, Rockville, MD (USA)). Oct 1987. 189p. NTIS, PC A09/MF A01.

Changing federal policies have encouraged communities to look beyond the impediments to contracting and to consider the benefits of contracting with private operators for portions of their transit services. This handbook addresses the procedural difficulties involved in the development of contractual relationships between private operators and public agencies. It focuses on transit programs (funded by UMTA) and practical how-to-do-it information about service contracting. The handbook is a valuable resource for private operators opting to improve the effectiveness of their contracting efforts with local governments. It is organized into seven chapters. Chapters 2, 3 and 4 provide background information on new market opportunities, funding programs, and the local transportation-planning process. These chapters are necessary for understanding how to effectively participate in public-transit programs. The last four chapters deal with the contracting process, how to win contracts, and contracts (types, requirements, problem areas). The appendices provide a sample contract, glossary, excerpts from UMTA Regulations and Third Party Guidelines, documentation of Private Enterprise Participation, and capital cost of contracting.

831 **(PB—88-239140/XAB) Airport shared-ride taxi programs in New York, Chicago and Boston. Final report, September 1978-June 1982.** Clarke, M.; Freilich, J. (COMSIS Corp., Wheaton, MD (USA)). Dec 1987. 129p. NTIS, PC A07/MF A01.

This report summarizes the development and operation of three shared-ride taxi operations at major US airports. These are: New York's LaGuardia Airport Share-A-Cab; Super Saver Taxi in Chicago; and Share-A-Cab service at Boston's Logan Airport. The Chicago operation provided service from O'Hare and Midway Airports and also, for a short time, within three downtown zones. The report presents information on ridership, costs, and special operating characteristics derived from personal interviews, on-site observations, and review of accumulated data. Special attention is paid to the institutional environment in which the services were implemented and the special role played by institutional and operational factors in the success or failure of the services.

832 **(PB—88-241971/XAB) Potential for optimizing public transit service through competitive contracting. Final report.** (American Bus Association, Washington, DC). Mar 1987. 104p. NTIS, PC A06/MF A01.

Competitive contracting has been used by many public-transit systems to preserve and improve public transit service by lowering costs and controlling cost increases. The purpose of this research was to assess the ability and interest of the private-bus industry to respond to the need for cost-effective and innovative public-transit services and the extent to which any assistance in public transit may be useful. Recommendations for UMTA action and research conclusions are also documented. Findings demonstrate that public-transit's basic fiscal problem is lack of cost control and not inadequate public funding, and the private bus industry is interested and capable of providing competitively contracted public-transit service.

833 **(PB—88-868922/XAB) Urban parking. January 1970-September 1988 (Citations from the NTIS data base). Report for January 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 161p. NTIS PC N01/MF N01.

Supersedes PB—87-862439.

This bibliography contains citations concerning the problems and proposed solutions associated with vehicle parking in urban areas. The use of park-and-ride facilities and satellite parking for public-transportation systems, airports, and central business districts is discussed. Management aspects, and studies performed at specific locations are also described. (This updated bibliography contains 279 citations, 10 of which are new entries to the previous edition.)

834 **(PNL-SA—15559) Description of an innovative vacuum pumping and energy absorption system for a multi-megawatt electric propulsion test facility.** Coomes, E.P.; Bennett, D.W.; Lundgren, R.A.; McClanahan, E.D.; Moss, R.W. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 9p. (CONF-880764—6). NTIS, PC A02/MF A01. Order Number DE89001736/JAW.

From 24. AIAA/ASME/SAE/ASEE joint propulsion conference; Boston, MA, USA (11 Jul 1988).

The development of high power electric propulsion, specifically the magnetoplasmadynamic (MPD) thrusters, is rapidly approaching an impasse to further development: the lack of a facility with adequate vacuum pumping and energy removal capacity to support the resolution of key life and performance issues by FY-93. Several vacuum systems or facility concepts have been proposed, but they will require significant research and development and the added development of a gas dynamic diffuser. To date, the workhorse for the vacuum processing industry for evacuating systems with high gas loads in the 10^{-4} to 10^{-5} Torr range is the circular cross-sectioned oil diffusion pump. Diffusion pumps can and have been operated with either low vapor pressure oils or suitable liquid metals. An innovative variation of the time-proven and reliable diffusion pump (known as the "strip" pump), coupled with current liquid metal technology, and a thorough understanding of the sputtering phenomenon, provides a viable vacuum pumping and energy absorption system concept. Practical speeds for these pumps in the molecular flow range are estimated to be 1 {times} 10^5 l/s/m^2.The major advantages of the strip pump are that its rectilinear geometry utilizes the inlet port area and chamber space more efficiently than the conventional cylindrical diffusion pump and that pumping capacity scale-up is obtained by adding replicate sections of pumps. 8 refs., 4 figs., 1 tab.

835 **(SAND—88-1520C) Experimental observations of low and zero gravity nonlinear fluid-spacecraft interaction.** Peterson, L.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 24p. (CONF-881076—6). NTIS, PC A03/MF A01. Order Number DE88015263/JAW.

From 59. shock and vibration symposium; Albuquerque, NM, USA (18 Oct 1988).

Low and zero gravity simulation experiments of the motion of a spacecraft coupled to the nonlinear slosh of a contained fluid are presented and discussed. A generic study model, in which a linear, spring-mass-damper spacecraft mode was coupled to the slosh of a fluid within an attached cylinder, has been studied experimentally using a unique, scale model apparatus. Low gravity was simulated in a 1 g laboratory using capillary (Bond number) scaled models, and zero gravity was simulated during experiments on the NASA KC-135 Reduced Gravity Test Facility. The mass fraction of fluid, the tuning ratio of the fluid and spacecraft vibrations, the spacecraft damping ratio, and the nondimensional gravity level were systematically varied. The nonlinear free decay response of the experimental systems exhibited system natural frequencies which varied in proportion to the square of the amplitude of the motion. The nonlinear resonance responses displayed harmonic, nonharmonic, planar, nonplanar, and spatially chaotic motions. These experimental responses can only be modeled by a nonlinear analytical model of the fluid coupled to the spacecraft model, and cannot be predicted by the simple linear slosh models currently in use. 8 refs., 15 figs., 1 tab.

836 **Single-ended counter-rotating radial turbine for space application.** Coomes, E.P.; Wilson, D.G.; Webb, B.J.; McCabe, S.J. US Patent Application 6-049,180. 13 May 1987. 13p. Contract AC06-76RL01830. NTIS, PC A03/MF A01.

A single-ended turbine with counter-rotating blades operating with sodium as the working fluid. The single-ended, counter-rotating feature of the turbine results in zero torque application to a space platform. Thus, maneuvering of the platform is not adversely affected by the turbine. 4 figs.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 125, 327, 450, 671, 785

837 **(BFR-R—85-1987) Heat recovery and flue gas cleaning for medium-sized oil-fired boilers.** Johansson, U.; Lagerkvist, K.O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 35p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755034/JAW.

By leading the flue gases from the boiler to flue gas cooling equipment, constructed from a suitable choice of materials and incorporating special design features in the heat exchanger, it is possible to reduce the temperature of the outgoing flue gases to below both the acid and the water vapour dewpoints. This increases the overall energy yield and also cleans the flue gases. From 1984 until the autumn of 1986, the performance of a condensing flue gas cooler has been monitored and evaluated. The work, which has been carried out in an experimental installation, consisting of a boiler plant supplying heat to terrace houses, has investigated the resulting energy saving, the efficacy of sulphur and particulate matter removal, composition of the condensate and the reduction in flow losses. Under normal operating conditions, energy recovery from the flue gases has amounted to 10 - 15%. Depending on the type of heat sink and boiler status, the total savings potential could be anything up to 25%. (authors).

838 **(DOE/RL/01830—T60) The US glass industry: An energy perspective.** Babcock, E.; Elaahi, A.; Lowitt, H.E. (Energetics, Inc., Columbia, MD (USA)). Sep 1988. Contract AC06-76RL01830. 222p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88016850/JAW.

This report investigates the state of the US glass industry in terms of energy consumption and conservation. The specific objectives were: to update and verify energy consumption and production data for the various process steps in 1985; to determine the potential energy savings attainable by replacing current practices with state-of-the-art and advanced (year 2010) production practices and technologies; and to identify areas of research and development opportunity that will enable these potential future savings to be achieved. The results of this study concluded that for the year 2010 production level, there is potential to save between 21 and 44 percent of the projected energy use by replacing current technology practices with state-of-the-art and advanced technologies. R&D needs and opportunities were identified for the industry. Potential R&D candidates for DOE involvement were selected from the identified list, primarily based on their energy savings potential and the opinions of industry experts. 100 refs.

839 **(ORNL/Sub—86-22020/1) Assessment of the thermal and physical properties of masonry block products.** Valore, R. Jr.; Tuluca, A.; Caputo, A. (Oak Ridge National Lab., TN (USA); Winter (Steven) Associates, Inc., New York (USA)). Sep 1988. Contract AC05-84OR21400. 224p. NTIS, PC A10. Order Number DE89001314/JAW.

The objective of this study was to assess the current knowledge on the thermal and physical properties of concrete masonry units and fired clay bricks, and to outline directions for further research. In particular, the authors attempted to uncover the areas where thermal properties data are missing or are questionable, to define the type of testing required to fill in the gaps, and to characterize representative masonry blocks on which the testing should be undertaken. US building codes and standards were examined with respect to the thermal properties of masonry block products. It was concluded that the majority of these codes and standards contain insufficient and/or outdated information regarding concrete masonry units and fired clay bricks, thereby distorting the requirements for walls built with masonry units. A comprehensive bibliography search was performed and the thermal properties data obtained were listed and analyzed. Relationships were derived between oven dry density and thermal conductivity for various concretes, clays, and loose fills. The relationship between moisture content and thermal conductivity was also examined. Areas with incomplete and/or contradictory information were identified. Based on these data gaps and on data quality problems, new testing programs were recommended and improvements to current testing procedures were proposed. The study also suggest low-cost test procedures which could be applied to large numbers of masonry blocks. 228 refs., 26 figs., 31 tabs.

840 **(STEV-FGT—88-4) Gasification in a circulating fluidized bed as oil substitution in lime kilns.** Lindman, N. (Goetaverken Energy AB, Goeteborg (SE)). (Statens Energiverk, Stockholm (Sweden)). Apr 1988. 25p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755087/JAW.

During the second phase of the project 'Foersoeksanlaeggning - GES', January 1987-December 1987, Goetaverken Energy AB carried out experiments in a pilot plant for gasification of biofuels in a circulating fluidised bed. The plant has a capacity of 400 kg per hour. A total of 200 hours experimental runs have been performed in order to give a base for process optimization. The commercial application of the gasification process is mainly for oil substitution in the lime kilns of the kraft pulp industry.

841 **(STU—85-3983) Energy efficient model sawmill.** Ahlbeck, B.; Joensson, O.; Svensson, E. (AaF Energikonsult Syd, Malmoe (SE)). (Swedish National Board for Technical Development, Stockholm). Dec 1986. 128p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755107/JAW.

The aim of the project is to demonstrate how to design and construct an energy efficient sawmill. The entire bulk of bark, chips and sawdust produced at the mill is dried by flue gas in a fuel dryer. Fuel burnt in the mill kiln is dried to 50% moisture. The remaining part is dried to 15% and compressed into briquettes. Payoff time for fuel dryer and briquette press is estimated to 1.5 years. Internal electricity production was studied but was found to be non-profitable for the present. Losses in the heat distribution system are reduced by keeping a large temperature difference between

supply and return water, and by short pipe lengths. The main yield is dried in compartment kilns and the side boards in a progressive kiln. Specific heat consumption is estimated to respectively 217 kWh/m/sup 3/ and 272 kWh/m/sup 3/. Specific electricity consumption amounts to respectively 17 kWh/m/sup 3/ and 15 kWh/m/sup 3/. Specific energy consumption for space heating amounts to 20 kWh/m/sup 3/ in the saw and sorting spaces, 11 kWh/m/sup 3/ in the adjustment works and 30 kWh/m/sup 3/ in planing works.

842 **(N—88-25922) Investigation of rolling contact fatigue of ball bearings.** Soda, N. (National Aeronautics and Space Administration, Washington, DC (USA)). Jul 1988. Translation of Japan Society for the Promotion of Science, Research Committee (Japan), no. 126, 1-155(1987). (NASA-TT—20196; NAS—1.77:20196). 218p. NTIS, PC A10/MF A01.

Tests were carried out using solid lubricants of two types with molybdenum disulphide additive, and another single type with graphite additive. The following results were obtained: (1) Solid lubricant has a tendency to decrease bearing life 50 to 70 percent. This tendency becomes striking when the particle size is large, as with molybdenum disulfide. Also graphite has a shortening effect in the first stage of operation but this disappears as opertaion time increases; (2) The influence of solid lubricant on bearing life is mainly to decrease outer ring life; and (3) Even in grease with solid lubricant added, there is a bearing life of twice that with oil lubrication.

843 **Two component absorption/phase separation chemical heat pump to provide temperature amplification to waste heat streams.** Scott, T.C.; Kaplan, S.I. US Patent Application 6-092,910. 4 Sep 1987. 14p. Contract AC05-84OR21400. NTIS, PC A03/MF A01.

A chemical heat pump that utilizes liquid/liquid phase separation rather than evaporation to separate two components in a heat of mixing chemical heat pump process. 3 figs.

844 **Method and apparatus for removal of gaseous, liquid and particulate contaminants from molten metals.** Hobson, D.O.; Alexeff, I.; Sikka, V.K. US Patent Application 6-083,482. 10 Aug 1987. 27p. Contract AC05-84OR21400. NTIS, PC A03/MF A01.

Method and apparatus for removal of nonelectrically-conducting gaseous, liquid, and particulate contaminants from molten metal compositions by applying a force thereto. The force (commonly referred to as the Lorentz Force) exerted by simultaneous application of an electric field and a magnetic field on a molten conductor causes an increase, in the same direction as the force, in the apparent specific gravity thereof, but does not affect the nonconducting materials. This difference in apparent densities cause the nonconducting materials to "float" in the opposite direction from the Lorentz Force at a rapid rate. Means are further provided for removal of the contaminants and prevention of stirring due to rotational forces generated by the applied fields. 6 figs.

845 **Removal of copper from ferrous scrap.** Blander, M.; Sinha, S.N. US Patent Application 6-079,389. 30 Jul 1987. 11p. Contract W-31109-ENG-38. NTIS, PC A03/MF A01.

A process for removing copper from ferrous or other metal scrap in which the scrap is contacted with a polyvalent metal sulfide slag in the presence of an excess of copper-sulfide forming additive to convert the copper to copper sulfide which is extracted into the slag to provide a ratio of copper in the slag to copper in the metal scrap of at least about 10.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 541, 669, 698, 722, 774, 796, 798, 1697, 1721

846 **(AD-A—195527/7/XAB) Comparison of the composition and properties of municipal solid-waste incinerator ashes based on incinerator configuration and operation. Final report.** Ontiveros, J.L. (Army Military Personnel Center, Alexandria, VA (USA)). May 1988. 377p. NTIS, PC A17/MF A01.

Disposal of municipal solid wastes(MSW) is becoming a problem nationwide. Many sanitary landfills are either closing or approaching maximum capacity. With new landfills becoming difficult to site, alternative methods must be used to reduce the volume being disposed in landfills. Incineration, through thermal destruction, reduces the volume of MSW by up to 85%. However, problems do exist with the resulting fly and bottom ashes. Metals are not destroyed by this process, but are concentrated within the ashes. A majority of the ashes fail EPA's Extraction Procedure Toxicity Test by exceeding either cadmium or lead concentration limits. The objectives of this dissertation were threefold: i) examine the physical and chemical properties of ashes; ii) determine ash composition and morphology; and iii) determine extractive behavior of cadmium, chromium, and lead in an aqueous environment. Three different incinerators, from Canada, Massachusetts, and New Jersey, burning primarily residential MSW, were chosen to determine equipment and operational effects on ash composition and extractive behavior. Supplemental combustion air provided more complete combustion. Cadmium, potassium and sodium preferentially partitioned to the fly ash with lead partitioning differently between fly and bottom ashes depending on the incinerator. Fly ash morphology and composition did not vary significantly between incinerators. The ash matrices were composed primarily of complex, multi-substituted aluminosilicates, amorphous glass, and iron oxides. $CaSO_4$, NaCl and KCl were the predominate species. SEM micrographs showed a variety of shapes throughout the particle ranges with crystals heavily dispersed on the surfaces.

847 **(AFME—85-91-1003-5) Hot water network technology.** Potier, D. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 56p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755313/JAW.

A review of the present technology used in district heating and heat networks is presented. After a detailed description of the various existing systems and the joining technics, a study have been conducted concerning the parameters that have to be considered when checking the quality of the joint; the different test methods are described and evaluated (environment, mechanical resistance, thermal strains...).

848 **(BFR-R—2-1988) Heat extracted from the ventilation air of sewers. Pre-projecting, 50 flats, Haesselby square.** Karlsson, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 21p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755012/JAW.

In sewers of today there is a total accessible amount of heat of about 30 TWh/year. Due to the kind and composition of the pollutant it has been difficult to economically recover some of the thermal energy. There is now a new unconventional method which easily recovers heat out of the sewer system without direct contact with the polluted water. Existing sewers are here utilized as heat exchangers and a controlled airflow is led through the system, thus absorbing heat from the sewage and the ambient ground. The absorbed heat is recovered in conventional heat pumps connected to the building in question thus utilizing heat from the ventilation outlets of the buildings by mixing the air with the airflow from the sewer ventillation. In this study a pre-project is made for a building of 50 flats. The result from the study shows a net saving of 3000-8000 kWh/flat and year. To gain this an investment of about SEK 2000-6000 per flat will be necessary. The study implies that these investments and savings ought to lead to a full scale project for the building. (L.F.).

849 **(BFR-R—44-1988) Technology procurement for ground heat stores.** Rydell, B.; Sundberg, J.; Lundin, S.E. (Statens Geotekniska Inst., Linkoeping (Sweden); Kjessler and Mannerstraale, Stockholm (SE)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1988. 83p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755024/JAW.

The objective of this work has been to clarify the potential of, and identify markets for, ground heat stores in clay. The results are intended to serve as a basis for technology procurement of a number of heat supply systems using heat pumps and ground heat stores. The report describes a model for technology procurement of ground heat stores, to be carried out in a specification stage and a prototype stage. The specification stage will be used to clarify certain basic characteristics, to prepare an enquiry specification and to negotiate the first phase of the technical development work. The prototype phase will be used to carry out technical development, perform pilot trials and construct prototype installations in full scale in various geological environments. Provided that commercially attractive cost levels can be achieved, this will then be followed by a series phase, with the objective of building about 10-15 such installations. After evaluation of tenders and joint negotiation, the various projects will be carried out under individual contracts between the purchasers and suppliers/contractors. (authors).

850 **(BFR-R—114-1987) District heating systems with directly-connected consumer service units.** Lagergren, S.; Lundborg, H. (Vattenbyggnadsbyraan, Stockholm (Sweden)). (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 89p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755042/JAW.

Consumers are connected to present-day Swedish district heating systems almost exclusively by indirect connection. District heating systems in other countries often employ both direct and indirect connection of consumers. Direct connection normally means that heat exchangers are not used, so that the district heating water circulates in the consumers' heating systems. The objective of this report is to document the construction and operation of both direct and indirect district heating systems. It considers such aspects as overall system economics and costs for consumer service units. One of the observations is that the capital cost of changing a small heating system from local oil firing to taking a district heating supply can be reduced by 10-20% if direct rather than indirect connection is used. The work has been largely carried out as a literature investigation, comparing national standards and rules in Sweden, Denmark and the Federal Republic of Germany. (With 30 refs.) (authors).

851 **(CONF-8810173—1) Benefits of advanced working fluids for DHC [district heating and cooling] systems.** Choi, U.S.; Kasza, K.E. (Argonne National Lab., IL (USA)). Sep 1988. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01. Order Number DE89000528/JAW.

From Workshop on energy conservation; Daejun, Korea (5 Oct 1988).

DHC projects have positive economic and community development rewards. Today the US DHC industry has moved beyond a market consisting of institutional and military-base systems to community energy systems which cover the central business district and adjoining high density areas as well as communities that need revitalization and new development. One day DHC may be a national industry when DHC is married to electric utilities by recovering waste heat from nuclear or coal power plants (rather than wasting it causing thermal pollution) and supplying heat to customers through the DHC loop as is done in several European countries. These cogenerative DHC systems will make a significant impact on energy conservation and create the most reliable and efficient electric utility systems. The objectives of this paper, are to review the benefits and barriers of conventional DHC technology, introduce the concepts of advanced working fluids and consider the potential benefits of these advanced working fluids for DHC systems. 5 refs.

852 **(NEI-SE—22) Combined heat and power -87.** (Statens Energiverk, Stockholm (Sweden)). 5 Nov 1987. 74p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755056/JAW.

Cogeneration plants in Swedish municipalities and industry are reviewed in this report. The installed electric power capacities are about 7 and 5 TWh/year, respectively, for these plants. Installations planned for the next decade are also listed, and some questions regarding taxes are discussed. (L.E.).

853 **(PB—88-245873/XAB) Design and analysis of a Stirling engine-based cogeneration system and gas/solar hybrid small power producer. Final report, October 1985-July 1986.** Washom, B.J.; Ziph, B.; Godett, T.M.; Kearney, D. (Advanco Corp., Beverly Hills, CA (USA)). Jun 1987. 210p. NTIS, PC A10/MF A01.

A design was developed for a gas combustor with a sodium heat pipe to be coupled with a high-efficiency Stirling Power Conversion System (PCS) for the cogeneration and solar market. The power application ranged between 25 kWe for the solar case and 75 kWe for cogeneration. Economic analysis determined the performance and operating and maintenance requirements for the widest market penetration. The PCS consists of a STM4-120 Stirling engine; solar/gas-fired hybrid receiver; induction generator and grid-interface hardware; cooling system comprising a closed-loop liquid-coolant circuit and a liquid-to-air heat exchanger with fan; control system governing all system function except solar tracking; and mechanical interface of the PCS with a particular parabolic collector to be identified. Analysis results and potential applications are discussed in appendices.

854 **(PB—88-247549/XAB) Development of a light-duty gas engine for cogeneration service. Annual report, June 1986-May 1987. Technical report.** DiNanno, L.; Raymond, R. (TECOGEN, Inc., Waltham, MA (USA)). Aug 1988. 151p. (TE—4370-107-88). NTIS, PC A08/MF A01.

See also Annual report for 1986, PB—87-221297.

This report covers the second year activities of a program undertaken to improve the performance and maintenance requirements of a light-duty gas engine for cogeneration service. The subject engine is a 454 cu-in-displacement automotive gasoline engine converted to operate on natural gas. The engine is currently used in cogeneration and as a compressor drive for air-conditioning applications. It is the object of the program to improve the engine's performance in terms of output and efficiency, to reduce its service requirements, and to identify its emissions characteristics, thereby enhancing gas-fired cogeneration applications.

855 (SERI/SP—231-3331, pp 201-212) **Effluent dewatering research for MSW and wastewater treatment sludges.** Pearson, C.V. (Argonne National Lab., IL (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW. Contract W-31-109-ENG-38.

In FY 1987 anaerobic digestion: Annual report.

Since 1983 the program for investigation of methods to achieve near energy independence in wastewater treatment plants has focused on two areas that have the greatest possibility for energy reduction and subsequent energy production in the processing of municipal wastewater. Development of a low energy process to produce combustor-fuel-quality sludge has been the primary focus of the program. Two processes have been investigated namely, the BMI electro-acoustic process and the low-grade energy, contact-drier process being developed at Clemson University. Both processes have achieved solids concentrations of from 37 to 45% using no more energy than is required by conventional equipment to achieve 15 to 22% solids. The end-product is autogenous and appears to be capable of being burned for energy production as a single fuel and is able to achieve the desired 1500 to 1700°F flame temperature required for odor control.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 759

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 16, 74, 83, 313, 864

856 **(AD-A—196326/3/XAB) Fuel-related problems in vehicles and equipment. Final report, March-December 1987.** Swann, M. (Army Belvoir Research Development and Engineering Center, Fort Belvoir, VA (USA)). Jun 1988. 52p. (BRDEC—2468). NTIS, PC A04/MF A01.

A field quality survey was distributed in an attempt to define the magnitude of the overall diesel-fuels quality issue. This questionnaire was sent to 61 US Army Logistic Assistance Offices and Reserve Components Support Offices, with secondary distribution encouraged. There were 131 responses to the questionnaire. As a result of this questionnaire, it is realized that the quality of fuels can have serious consequences on the mission of the Department of Defense (DoD) by degrading vehicles, equipment, and weapons-systems performance and by damaging critical vehicles, equipment, and weapons components. Because DoD's highest-priority goal in mobility fuels technology is to achieve the capability of utilizing fuels which are now readily available and are projected to be available from the commercial sector, officials must be aware of the problems experienced in the field.

857 **(DOE/CE/15327—T4) Diesel engine regenerative filter development: Combined quarterly progress reports No. 4 and 5 for the periods ending April 30, 1988 and July 31, 1988.** Lefkowitz, L.R. (Compix Enterprises, Inc., Latham, NY (USA)). 25 Aug 1988. Contract FG01-87CE15327. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88015674/JAW.

As diesel engines operate on an efficient thermodynamic cycle at a low economic cost, their excessive particulate pollution has been tolerated. However, the Environmental Protection Agency (EPA) is now setting more stringent particulate emission standards to be met by all diesel powered vehicles. One candidate design to meet the new EPA requirements is a continuously regenerative trap oxidizer device designed and manufactured by Compix Incorporated. A test program was initiated to evaluate the design and performance of this Diesel Particulate Filter (DPF) on a research diesel engine at Drexel University. This DPF is comprised of a rotating porous metal filter element driven by a variable speed electric motor, a heater element for filter regeneration, a nozzle for controlling the particulate deposit pattern on the filter element, and a stainless steel housing. After several weeks of attempted testing it became apparent that the original design was inadequate for reliable testing due to a severe leakage problem and the binding of the rotating filter element with the filter housing. Therefore, it was determined that a new design was necessary for the filter housing. During the time while the new design was being fabricated, some preliminary testing on the original design was completed. This testing was aimed at determining the optimum filter porosity, the effects of the nozzle section and surface catalysts. The results of these preliminary tests will be used when testing begins with the new housing design in the near future. 9 refs., 2 figs., 2 tabs.

858 **(DOE/MC/22181—2536) Economic assessment of coal-burning locomotives: Topical report.** (General Electric Co., Erie, PA (USA). Transportation Systems Business Operation). Feb 1986. Contract AC21-85MC22181. 329p. NTIS, PC A15. Order Number TI88001032/JAW.

The General Electric Company embarked upon a study to evaluate various alternatives for the design and manufacture a coal fired locomotive considering various prime movers, but retaining the electric drive transmission. The initial study was supported by the Burlington-Northern and Norfolk-Southern railroads, and included the following alternatives: coal fired diesel locomotive; direct fired gas turbine locomotives; direct fired gas turbine locomotive with steam injection; raw coal gasifier gas turbine locomotive; and raw coal fluid bed steam turbine locomotive. All alternatives use the electric drive transmission and were selected for final evaluation. The first three would use a coal water slurry as a fuel, which must be produced by new processing plants. Therefore, use of a slurry would require a significant plant capital investment. The last two would use classified run-of-the-mine (ROM) coal with much less capital expenditure. Coal fueling stations would be required but are significantly lower in capital cost than a coal slurry plant. For any coal fired locomotive to be commercially viable, it must pass the following criteria: be technically feasible and environmentally acceptable; meet railroads' financial expectations; and offer an attractive return to the locomotive manufacturer. These three criteria are reviewed in the report.

859 **(NMAB—431) Ceramic technology for advanced heat engines.** (National Materials Advisory Board (NRC), Washington, DC (USA)). 1987. Contract AC01-85CE50083. 67p. NTIS, PC A04/MF A01. Order Number DE89001634/JAW.

The goal of the Department of Energy-Oak Ridge National Laboratory program on ceramic technology for advanced heat engines is "to apply the increasing base of fundamental knowledge and research tools to develop new and improved processes for cost-effective ceramic materials with improved reliability and performance characteristics. " A committee appointed to review the program assessed the objectives, balance, and priorities. Emerging opportunities were identified, an international exchange agreement was examined, and the mechanisms of technology transfer were investigated. Coordination efforts were studied, and the technical planning for the program was critiqued. The committee believes that many but not all of the most important components of the basic ceramic technology relating to improved performance and reliability are being addressed. Although the committee did not examine individual projects in detail, it feels that the general quality of the technical work is good. The committee is less certain that progress is being made in bringing these components together into a technically successful process for producing final ceramic products with significantly improved reliability and performance. Also, the committee finds little evidence that substantial progress toward cost-effective processing is being made. Indeed, there appears to be no organized attempt to do our cost analysis. 16 refs., 6 figs., 3 tabs.

860 **(UCRL—99710) Computer modeling of engine knock chemistry.** Westbrook, C.K.; Pitz, W.J. (Lawrence Livermore National Lab., CA (USA)). 12 Sep 1988. Contract W-7405-ENG-48. 19p. (CONF-881130—2). NTIS, PC A03/MF A01. Order Number DE89001713/JAW.

From The supercomputing conference; Kissimmee, FL, USA (14 Nov 1988).

The development of detailed chemical kinetic reaction mechanisms for analysis of autoignition and knocking of complex hydrocarbon fuels is described. The wide ranges of temperature and pressure which are encountered by end gases in automobile engine combustion chambers result in extreme demands on the reaction mechanisms intended to describe knocking conditions. The reactions and chemical species which are most important in each temperature and pressure regime are discussed, and the validation of these reaction mechanisms through comparison with idealized experimental results is described. The use of these mechanisms is illustrated through comparisons between computed results and experimental data obtained in actual knocking engines. 20 refs., 3 figs., 1 tab.

3302 External Combustion Engines

861 **(DOE/NASA/50112—75) Testing of a variable-stroke Stirling engine.** Thieme, L.G.; Allen, D.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. Contract AI01-85CE50112. 28p. (CONF-860810—50; NASA-TM—100899). NTIS, PC A03/MF A01. Order Number DE89002381/JAW.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

Testing of a variable-stroke Stirling engine at NASA Lewis has been completed. In support of the US Department of Energy's Stirling Engine Highway Vehicle Systems Program, the engine was tested for about 70 hr total with both helium and hydrogen working fluids over a range of pressures and strokes. A direct comparison was made of part-load efficiencies obtained with variable-stroke and variable-pressure operation. Two failures with the variable-angle swash-plate drive system limited testing to low power levels. These failures are not thought to be caused by problems inherent in the variable-stroke concept but they do emphasize the need for careful design in the area of the crossheads where the failures occurred. This paper describes these failures and the efforts to resolve the associated problems, and presents test results that were obtained. 5 refs., 17 figs.

862 **(PB—88-235619/XAB) Far-infrared detector for in-situ monitoring of the carbon content of diesel-engine oils. Final report on Phase 1, 1 February-28 December 1985.** Hilliard, J.C.; Chan, A.K.F.; Chiesa, C.; Schafer, J.; Strassburger, R.S. (CFR, Inc., Ann Arbor, MI (USA)). Dec 1985. 24p. NTIS, PC A03/MF A01.

Using a Fabry-Perot type etalon, the research successfully demonstrated the potential to use specific-wavelength ranges in the infrared as a means of quantitative assessment of the carbon content of diesel-engine oils. The technique identified a steep change in transmissivity function with oil use, and has been proposed as a means of identifying imminent dispersant failure of oils in service, and the criterion for oil change. Although potassium bromide optical components were used for the quantitative work of the study, results are presented to show the possibilities of inexpensive, polymeric elements for cell construction. The work was performed on both synthetic and mineral-based oils. The salient features pertinent to the application of the technique for each oil type are presented.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 677, 678

863 **(EGG-M—88117) Assessment of battery technologies for EV [electric vehicle] applications.** Ratner, E.Z.; Henriksen, G.L.; Warde, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 8p. (CONF-881162—1). NTIS, PC A02/MF A01. Order Number DE88015226/JAW.

From 9. electric vehicle symposium; Toronto, Canada (13 Nov 1988).

To guide future R&D program planning, the US Department of Energy (DOE) commissioned an assessment of all viable battery techniques for EV applications. Sixty-seven technology developers in the United States, Canada, Europe, Asia, and Africa were solicited to design a power pack for an "Improved Dual-Shaft Electric Propulsions" (IDSEP) van. A team of 10 consultants and 8 representatives from DOE's National Laboratories evaluated 43 developers responses and consultant-prepared conceptual designs. Using six criteria---five technical/economic criteria and a maturity/technical barriers criterion---the assessment identified 12 most promising battery technologies. 5 refs., 1 fig., 4 tabs.

3307 Emission Control

REFER ALSO TO CITATION(S) 377, 857, 1011, 1672

864 **(PB—88-232046/XAB) Trends in motor-vehicle emission and fuel-consumption regulations - 1988 update.** McArragher, J.S.; Tims, J.M.; Rickeard, D.J.; Perfetti, P.; Schug, P. (Concawe, The Hague (Netherlands)). 1988. 74p. (CONCAWE—4/88). NTIS, PC E04/MF A01.

This report is the latest of the updates prepared annually by CONCAWE to record changes in national and international laws and regulations relating to motor-vehicle emissions, fuel specifications and fuel consumption on a world-wide basis. It is published as a yellow general circulation report for the first time, previous issues having been in the white special interest report series.

865 **(SNV—3170) Exhaust gas purification - diesel vehicles.** Bjoerkman, E.; Egebaeck, K.E.; Graegg, K. (Statens Naturvaardsverk, Nykoeping (SE)). (National Swedish Environmental Protection Board, Solna). Sep 1986. 35p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755071/JAW.

Two particulate traps and a catalyst were tested in a diesel engine powered truck, operated on a chassis dynamometer by three different driving patterns. Measurements were made of emissions of carbon oxides, hydrocarbons, nitrogen oxides, and particulate matter. It was established that: -the particulate traps hardly have an effect on emissions of carbon monoxide, hydrocarbons and nitrogen oxides, -the traps reduce the amount of emitted particulate matter to a relatively high extent, -the catalyst reduces emissions of carbon monoxide and hydrocarbons, -the catalyst does not have an appreciable influence on total nitrogen emission but increases the fraction of nitrogen dioxide, -the catalyst reduces the amount of emitted particulate matter. (O.S.).

866 **(SNV—3171) Particle traps - Diesel engines.** Bjoerkman, E.; Egebaeck, K.E.; Graegg, K. (Statens Naturvaardsverk, Nykoeping (SE)). (National Swedish Environmental Protection Board, Solna). Sep 1986. 24p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755072/JAW.

Two particulate traps were tested in a diesel engine powered truck, operated on a chassis dynamometer by three different driving patterns. Measurements were made of emissions of carbon oxides, hydrocarbons, nitrogen oxides, particulate matter, PAH, 1-nitropyrene and some selected aldehydes and ketones. Also the mutagenic potential of the exhaust gases was measured. During the measurements two different diesel fuels were examined, trade quality and so called light diesel. By using traps it was established that: -emissions of carbon monoxide and hydrocarbons were slightly lower in the transient cycles than in the 13-mode test, -emission of nitrogen oxides was hardly affected, -particulate emission was considerably reduced, -emission of PAH and 1-nitropyrene was considerably reduced, -the mutagenic potential of the exhaust gases was lowered, -total emission of aldehydes and ketones were not affected. In addition, by using trade quality diesel fuel, the particulate emission was considerably increased compared to light diesel fuel. (O.S.).

3308 Alternative Fuels

867 **(LBL—24213, pp 3.43-3.44) Alternative transportation fuels: the international experience.** Sathaye, J.A.; Atkinson, B. Mar 1988. NTIS, PC A04/MF A01. Order Number DE88014056/JAW.

In Energy Analysis Program, FY 1987: Applied Science Division Annual report.

Worldwide interest in alternative transportation fuels has risen considerably since the two oil price shocks in 1973 and 1979. The US Department of Energy is studying potential alternative fuel programs for the US transportation market. As part of this effort, LBL conducted an analysis of the international experience with alternative transport fuels and the implications for future US activities. LBL concentrated on those programs which had achieved commercial development, or at least a significant pilot project stage. Detailed studies were done for Canada, New Zealand and Brazil. Alternative fuel use in these countries and others is briefly summarized. Lessons for the US include the importance of government commitment and promotion, use of incentives such as guaranteed alternative fuel prices, grants and loans for conversion and fuel station construction, and fuel producer and distributor incentives. Information to boost public confidence in unfamiliar technologies is also essential. Involvement of state governments, automobile manufacturers, and energy companies in cooperation with the federal government is important in the initial stages as well as for the long-term economic success of alternative fuels. US decisions on alternative fuel programs will influence those of other countries, particularly Canada, but also Europe and Japan, as well as the developing countries. Automobile manufacturers and conversion technology companies will be affected by the direction of US programs.

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

868 **(AD-A—195742/2/XAB) Soviet Union and nuclear proliferation: policy at a crossroads. Study project.** Rigby, R.L. (Army War Coll., Carlisle Barracks, PA (USA)). 2 Apr 1988. 63p. NTIS, PC A04/MF A01.

The Soviet Union has been a major participant of the regime of nations dedicated to limiting the spread of nuclear weapons. Since the early 1960's the Soviet Union has worked closely with the United States to limit nuclear proliferation. In no other area of international relations have the stated goals of the two superpowers been more closely aligned. Recent events indicate that the Soviet Union has parted from the original intent of the Nuclear Non-Proliferation Treaty and of the International Atomic Energy Association nuclear safeguards and has begun assisting nations that are not participants of the non-proliferation regime. While not specifically calling for a revision of the Nuclear Non-proliferation Treaty, the Soviet Union has unilaterally assisted in the spread of nuclear technology to nations that have refused to become members of the nuclear non-proliferation regime. This assistance is examined in the context of the overall Soviet nuclear nonproliferation policy or simply placing political goals above that of international agreements is examined. The paper concludes that the Soviet Union will use nuclear technology as a tool to further its strategic goals.

869 **(AD-A—195743/0/XAB) Armored cavalry and reconnaissance: a doctrinal shortfall in force structure. Study project.** Rousek, C.A. (Army War Coll., Carlisle Barracks, PA (USA)). 15 Apr 1988. 77p. NTIS, PC A05/MF A01.

The parity of nuclear weapons between the United States and the Soviet Union has elevated the need and priority to continue our build-up and maintenance of a strong conventional force to insure a viable deterrent. Since 1980, the Congress and the Defense establishment have recognized our conventional military inferiority to the Soviets correlation of forces. There is, as the text of this paper substantiates, a critical shortfall in the balance and mix of our combat forces to implement and sustain our national defense and military strategy. One of the most significant structural voids contributing to this imbalance is in the arm of cavalry.

870 **(ORNL/TM—10730) Intergovernmental consultation and coordination: Mitigating public concerns relating to implementation of the US Army's chemical stockpile disposal program.** Feldman, D.L. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 54p. NTIS, PC A04/MF A01. Order Number DE89001334/JAW.

Intergovernmental consultation and coordination are means of incorporating the concerns of state and local governments, tribal nations, and the general public in the implementation of programs characterized by real or perceived high risk and public opposition. While incorporation of public concerns is required by law and regulation prior to commencement of programs generating significant environmental impact, agencies are given few guidelines as to how they may be encompassed, particularly during program implementation. This generic problem is complicated by national government supremacy in environmental policymaking, resistance by some agency personnel, historically, to broad public input and open decisionmaking, and the absence of prescribed mechanisms for mitigating public opposition in the law itself. Through an examination of democratic theory and the practical experience of intergovernmental consultation and coordination in comparable programs, such as those involving the disposal of nuclear waste, it is shown that effective consultation and coordination is contingent upon incorporation of four goals: (1) coherent understanding of the intent of federal law; (2) maintaining citizen concurrence and gaining public support for a program; (3) viewing consultation as a means of maximizing program legitimacy; and (4) commitment to the promotion of publically held democratic values. The potential for success of the Intergovernmental Consultation and Coordination Board (ICCB), designed to provide oversight and guidance for the US Army's Chemical Stockpile Disposal Program (CSDP), is assessed in light of these goals. 102 refs., 2 tabs.

871 **(RAND-P—7357) SDI and/or arms control.** Ochmanek, D.A. (RAND Corp., Santa Monica, CA (USA)). Aug 1987. 15p. NTIS, PC A03/MF A01.

A frame of reference is established which relates U.S. policies regarding both strategic defense and arms control to the deterrence of aggression and the limiting of damage should deterrence fail. Early deployment of an extensive but only partially effective strategic defense system could actually reduce security. However, strategic defense, if deployed in such a way that it did not damage the deterrent effect of assured retaliation, can make a profound contribution to national survival if deterrence failed and nuclear weapons were launched by accident or against all reason. Assured national survival, a more modest goal than perfect population defense, still presents problems of technical feasibility and possible destabilization if engaged in unilaterally. The U.S. should plan on the continued need for cooperation with the U.S.S.R. and for arms control. Policy implications include: (1) the need to reverse the erosion of the ABM treaty; (2) the desirability of enacting the 50 percent reduction negotiated in Reykjavik; and (3) during arms negotiations, the U.S. should maintain a vigorous strategic defense initiative (SDI) technology program.

3502 Proliferation

872 **(AD-A—195668/9/XAB) Scenarios of nuclear-escalation dominance and vulnerability. Final report, February-June 1988.** Tritten, J.J. (Naval Postgraduate School, Monterey, CA (USA)). 1 Jun 1988. 43p. (NPS—56-88-013). NTIS, PC A03/MF A01.

This document examines the role of strategic-missile-carrying submarines in deterrence and mission of attacking these forces during the conventional phase of a war. Strategies considered include wars originating in varying regions. Included is a discussion of varying locations for submarine deployments impacting on potential antisubmarine warfare campaigns. Escalation considerations include vertical, horizontal, and time. It concludes with analysis of possible arms-control regulations.

3503 Verification

873 **(UCID—21447) Technical critique of the undated paper by Veretennikov, Mikhaylov, Simonenko, and Belonosov, titled "methodological requirements to the design of test verification systems and analysis of the conformity of the corrtex method to these requirements".** Heusinkveld, M. (Lawrence Livermore National Lab., CA (USA)). 8 May 1987. Contract W-7405-ENG-48. 21p. NTIS, PC A03/MF A01. Order Number DE89001861/JAW.

A recent Soviet paper discussed the US proposal to add Corrtex to the verification system for yield measurements for the Threshold Test Ban Treaty. This paper presents some technical comments on the Soviet paper. Section 1 in the Soviet paper presents the general requirements for a satisfactory verification system. Section 2 describes Corrtex and discusses how it fulfills the requirements of Section 1. Section 3, titled "Uncertainties of the Hydrodynamic Method", presents some theory on shocks in gases and in solids, and discusses several aspects of this Corrtex application where errors in yield determination may be introduced. In the final section giving their conclusions, the Soviet authors in effect reject the use of Corrtex as a verification system. 5 figs., 9 figs., 1 tab.

36 MATERIALS

REFER ALSO TO CITATION(S) 1461

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 217, 251, 269, 299, 302, 303, 307, 308, 309, 310, 311, 312, 315, 316, 317, 318, 319, 320, 321, 323, 324, 325, 328, 329, 612, 613, 613, 614, 614, 715, 1052, 1052, 1095, 1117, 1128, 1161, 1321, 1324, 1326, 1330, 1331, 1332, 1333, 1334, 1336, 1337, 1339, 1342, 1345, 1350, 1352, 1353, 1357, 1358, 1359, 1360, 1362, 1364, 1365, 1366, 1370, 1372, 1378, 1379, 1380, 1381, 1385, 1386, 1387, 1388, 1392, 1393, 1395, 1396, 1397, 1398, 1399, 1400, 1402, 1404, 1405, 1406, 1406, 1406, 1407, 1408, 1409, 1413, 1418, 1419, 1420, 1421, 1422, 1424, 1425, 1426, 1427, 1428, 1429, 1430, 1431, 1431, 1432, 1432, 1432, 1433, 1433, 1434, 1434, 1435, 1437, 1438, 1439, 1439, 1440, 1440, 1441, 1442, 1444, 1446, 1447, 1447, 1449, 1450, 1451, 1452, 1452, 1453, 1455, 1459, 1467, 2410, 2448, 2464, 2584, 2655

874 (ACIESP—60-Vol.1, pp 46) **Latest development in metallic materials in Japan.** Yoshitsugu, M. (Tokyo Univ. (Japan)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

875 **(CONF-871234—15) Superplasticity and its application to near-net shaping of intermetallic alloys.** Sikka, V.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01. Order Number DE89001937/JAW.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Near-net-shape manufacturing offers the best approach for reducing the cost of a complex-shape component. Among various near-net-shape manufacturing techniques, superplastic forming is best suited for most complex shapes and for hard-to-fabricate materials. This paper describes the newly-developed nickel aluminide intermetallic alloys, use of superplastic forming for near-net-shape processing of these alloys, and mechanical properties and microstructures of the superplastically formed prototype disks out of these alloys. Mechanical properties and microstructures of superplastic disks are also compared with other near-net-shape and conventional processes used for nickel aluminides. Observed mechanical properties of the superplastic disk are explained based on its very fine grain size (10 μm). Nabarro-Herring creep mechanism was found suitable for explaining the observed creep behavior of nickel aluminide alloys. 10 refs., 15 figs.

876 **(CONF-881129—1) Design and MHD stability for horizontal electromagnetic continuous casting.** Hull, J.R.; Lari, R.J.; Praeg, W.F.; Turner, L.R.; Rote, D.M. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011191/JAW.

From International symposium on casting near net shape products; Honolulu, HI, USA (13 Nov 1988).

High-frequency electromagnetic (EM) fields are proposed for the continuous casting of thin sheets of metal in a horizontal orientation. Major EM components of the caster include a picture-frame magnet, conducting side guards for positioning and side containment, and an eddy current return path that requires an electrode near the inlet and pickup brushes or roller near the outlet of the caster. An inductance stabilization method provides global stability, and magnetic flux compression provides local stability. Stability analysis and EM heating constraints indicate that frequencies in the range of 25-100 kHz are desirable to levitate 6-mm-thick steel. For systems without active feedback, a conducting screen is required below the metal with a gap between the screen and the molten metal no more than twice the metal thickness. Experiments using 10-kHz EM fields to statically levitate sheets of molten tin indicate that dominant MHD instabilities correspond to theory. 23 refs., 3 figs.

877 **(CONF-881129—2) Coolant system considerations for electromagnetic continuous casting of steel.** Misra, B.; Battles, J.E.; Shah, V. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012070/JAW.

From International symposium on casting near net shape products; Honolulu, HI, USA (13 Nov 1988).

The success of electromagnetic continuous casting of sheet steel will depend, to a large extent, on the development of a coolant system. The problem of removing heat from the electromagnetic caster is compounded by the induced eddy current heating and limits imposed on the maximum mass flow rate of the coolant to avoid instability of EM levitation. Extensive theoretical and numerical analyses have been conducted to define the coolant requirements, to identify possible solution to these problems, and to select reference operating conditions. The results of these analyses on the coolant system requirements in terms of casting speed, magnet length, coolant mass flow rate, and characteristics of electromagnetic levitation show that augmentation of heat transfer by a factor of 2 to 3 would be necessary for an economically viable casting system. A study of the literature shows that this requirement can be easily met by a variety of methods. The results from using nomograms to study the effect of design and operating parameters on the electromagnetic casting process are also presented. 21 refs., 6 figs., 3 tabs.

878 **(DPST—88-719) Fracture toughness of irradiated Type 304 stainless steel.** Caskey, G.R. Jr.; Louthan, M.R. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 8 Aug 1988. Contract AC09-76SR00001. 23p. NTIS, PC A03/MF A01. Order Number DE89001644/JAW.

Experimental evaluation of the elastic-plastic fracture behavior of a Type 304 stainless steel sample irradiated to 1.9 displacements per atom (dpa) provided a J-integral value of 74kJ/m² for the beginning of stable, mechanically induced crack growth is about 1.4. The experimental measurements of the fracture resistance of a steel similar to that used in the SRP reactors demonstrate a safety factor in the fracture analysis of the reactor tanks. The lowest measured toughness was found in a specimen taken from the heat affected zone of a circumferential weld. The sample was oriented so that crack growth was essentially parallel to the principal direction of plastic deformation of the steel during fabrication. Because these toughness values were lower than any of the other experimental determinations of J/sub IC/ values for the irradiated stainless steel, an analysis for metallurgical causes of the low toughness was made. Metallographic examination of samples from the pipe section showed ferrite stringers and inclusions are aligned in the primary direction of plastic deformation during fabrication of the rolled plate used to form the pipe. Aligned defects are also known to lower the fracture resistance when crack growth is in the direction of alignment. The metallographic observations are thus consistent with the measured low toughness when crack growth was along the pipe axis and parallel to the aligned defects. Because the rolled plate used to fabricate the SRP reactor tanks should have a microstructure similar to the plate used to manufacture the pipe, the mechanical property-microstructure data evaluated in this memorandum and summarized in Reference 1 is considered applicable to the reactor tanks as well as the process water piping. 9 refs., 4 figs., 1 tab.

879 **(ECN—192) Post-irradiation creep properties of four plates and two forgings DIN 1.4948 steel from the SNR-300 permanent primary structures.** Schaaf, B. van der. (Netherlands Energy Research Foundation, Petten). Jan 1987. 184p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88780131/JAW.

The safety authorities, involved in the licensing procedure of the SNR-300, have required the determination of the irradiation effect on the heat-to-heat variation of tensile and creep properties of Werkst. No. DIN 1.4948 austenitic stainless steel. These data are lacking in the present cores and they are necessary for the design and safety considerations of the permanent structures. Results are presented of about 200 tests on irradiated and unirradiated material of 6 heats used in the production of the SNR-300 permanent structures. After irradiation in the HFR-Petten to neutron fluence relevant for the SNR-300 service conditions post-irradiation tensile and creep tests (up to 10,000 hrs rupture time) were performed in the temperature range 723 K to 923 K. All heats are embrittled by irradiation resulting in reduction of rupture times, creep strength and ultimate tensile strength. The considerable reduction is attributed to

helium enhanced intergranular creep crack growth, which reduces the ductility and strength, but does not effect the creep rate. The variation to tensile and creep properties is large and independent of irradiation. The minimum derived creep strength in irradiated condition drops below the values expected in the ASME Code and VdTuV Blatt. In design and safety analyses the irradiation effect on creep properties must be accounted for with an appropriate reduction factor. The predictions given, have to be verified with long-term creep tests and parts of the SNR surveillance programme. 182 figs., 17 refs. , 58 tabs.

880 (ECN—193) **Post-irradiation tensile, creep and creep rupture data of DIN 1.4948 steel weld metal, heat-affected zones and welded joints of the SNR-300 permanent primary structures.** Schaaf, B. van der. (Netherlands Energy Research Foundation, Petten). Jan 1987. 164p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780132/JAW.

DIN 1.4948 (Type 304) austenitic stainless steel has been tested for use in the SNR-300. Full weld metal specimens from a wide groove weld have been subjected to tensile and creep tests in as-deposited and stress-relieved condition. Heat-affected zones were simulated in full size standard specimens by subjecting raw cylinders to temperature cycles representative for the heat-affected zone (HAZ). The welded joints were taken from qualification welds from components, such as reactor vessel and core shield, built for the SNR-300. Half of all the specimens were irradiated in the HFR, Petten at 823 K submerged in sodium to a total neutron fluence, representative for end of life fluences of SNR-300 reactor vessel and shield tank. The tensile and creep properties of as-deposited and stress-relieved weld metal are not affected by the neutron irradiation. The stress relief treatment of 3 h at 1175 K improves both tensile and creep ductility, without affecting strength too much, by reducing the dislocation density in weld metal and HAZ and coarsening the carbides in weld metal. The HAZ shows a pronounced decrease in post-irradiation tensile ductility, strength, creep strength and ductility. Ductility of weld metal can be improved by stress-relieving and adapting the chemical composition of the filler metal. In order to prevent the HAZ to become the weakest link of a welded joint after irradiation grain growth and boron precipitation on grain boundaries must be suppressed. Low heat input welding techniques such as electron beam welding and automated gas metal arc welding might offer a solution for HAZ post- irradiation embrittlement. 144 figs., 20 refs., 45 tabs.

881 (EGG-M—88158) **Horizontal and vertical twin-belt casting of 1-inch-thin sections of sheet steel.** Moore, M.R.; Daniel, S.S.; Ozgu, M.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 43p. (CONF-881161—1). NTIS, PC A03/MF A01. Order Number DE88015126/JAW.

From AIME-TMS international symposium; Honolulu, HI, USA (13 Nov 1988).

Innovative horizontal and vertical twin-belt casting systems were developed and tested in casting trials to provide alternative approaches to solving the crux technical problem of feeding liquid steel into the thin mold gap so as to achieve the excellent as-cast surface quality necessary to allow subsequent direct rolling of top-quality sheet. The horizontal approach involved an innovative feeding system to feed the 1-inch-thick caster entry, but the twin-belt Hazelett machine itself was largely conventional. In contrast, the opened-up entry of the vertical twin-belt machine allowed the use of conventional lathe tube and flux pouring systems, but the machine itself was complex and deformed the casting down to the 1-inch thickness. Extensive modeling work was done to support both approaches. 15 refs., 21 figs., 1 tab.

882 (EPRI-NP—5928-Vol.3) **Supplementary examination of alternative materials in a model steam generator: Volume 3, tube characterization by metallography and transmission electron microscopy: Final report.** Krupowicz, J.J.; Stubbins, J.F.; Mehler, M. (Electric Power Research Inst., Palo Alto, CA (USA); Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). Oct 1988. 160p. Research Reports Center, Box 50490, Palo Alto, CA 94303.. Order Number TI89002056/JAW.

The microstructural characteristics of current and candidate alloys for steam generator heat transfer tubing were determined utilizing a variety of techniques. Mill annealed heats of Alloys 690 and 800NG were examined as well as heats of Alloy 600 in the mill annealed, process stabilized, sensitized and thermally treated conditions. Characterization included optical microscopy, transmission electron microscopy and scanning transmission electron microscopy of these materials in their pre- and post-test conditions (i.e., archive and exposure for 11,328 hours to 621{degree}F primary temperature). The results were utilized to elicit comparisons of these materials to stress corrosion cracking resistance in sulfate faulted secondary environments. 83 figs., 8 tabs.

883 (INIS-mf—11312, pp 71-75) **Neutron radiography investigation of plastic deformation of metals and alloys.** Kalchevska, K.Kh. 1987. (In Russian). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The method is described which uses a radioactive coordinate lattice for investigating plastic deformation of metals and alloys. The collimator for producing the coordinate net consists of a bimetallic plate with channels permeable for neutrons, and allows the formation of lines 0.2 mm thick in steps of 1 mm. Samples are explosion-welded. The radiograms are then evaluated using a densitometer. The error of the coordinate net is ca. 3-4 %. The method allows to determine deformations at the point where two materials are joined as well as the depth distribution of the deformation. Examples of deformed layers are presented. (J.B.). 7 figs., 3 refs.

884 (INIS-mf—11312, pp 155-162) **Optimization by neutron-induced autoradiography of grain refinement in cast aluminium strip production.** Rachlitz, R. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Neutron radiography was used to determine the distribution and content of boron in the AlTi5B1 alloy. Metallurgically treated samples were irradiated in a reactor with a flux density of 1.35x10/sup 13/ cm/sup -2/s/sup -1/. The density of boron tracks was measured using equipment consisting of a microcomputer with a 256 k main memory and the necessary peripherals, a graphics display with image memory and a color monitor, and a unit of ball feed. It was proved that by mere irradiation of the sample with thermal neutrons sufficiently accurate information may be obtained on the distribution and content of boron in fine-grain aluminium. (Z.S.). 9 figs.

885 (INIS-mf—11312, pp 198-202) **Radioactive tracer study of direct chlorination.** Vanicek, M.; Mayer, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Phase analysis provides information on micropurity and the phase composition of steel such as have effect on its utility properties. The method of radioactive tracers was used to study the process of direct chlorination on a routine device for separating oxide inclusions. The spectrometric method was used for measuring samples of material processed on key moments of the process. The efficiency of the separation of oxide inclusions was studied using radionuclide /sup 141/Ce. The method of direct chlorination was used to process steel slag with labelled CeO/sub 2/, the Al-Ce alloy for the study of steel deoxidation and steel samples containing radioactive ceric oxide in form of inclusions. Also studied was the behavior of synthetic carbides of tungsten, molybdenum, chromium and tantalum during chlorination, using radionuclides generated during the activation of carbides by neutrons. (author). 1 fig., 2 tabs.

886 (INIS-mf—11312, pp 203-210) **Application of /sup 55/Fe radionuclide in studying kinetics of alloying addition dissolution in steels.** Habrman, P. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

A method is presented which is mainly designed for the study of the transfer of atoms owing to transfer phenomena, for 11 elements Mg to V (arranged by rising proton number with the exception of Ar) in iron labelled with its radioactive isotope /sup 55/Fe. The method also uses the advantages of tracer techniques and of X-ray fluorescence analysis. It allows to attain some better results, mainly with regard to location, as compared with those achieved by each of the methods implemented separately. The method is demonstrated on the study of the kinetics of the dissolution of ferrosilicon in melted iron - research which is very important for metallurgical practice. (author). 2 figs., 13 refs.

887 (INIS-mf—11312, pp 219-226) **Application of nuclear methods in studying quality of stainless steel surfaces.** Bystriansky, J.; Mayer, J. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The corrosion resistance of austenitic CrNiMo steels in passive state is dependent on the quality of the passivating layer and on the composition of the corrosion medium. The quality of the surface layers of steels was studied by gamma spectrometry following the activation of steel samples by neutrons in a nuclear reactor. In the measured solutions obtained by controlled dissolution of irradiated material the presence was quantitatively determined of radionuclides /sup 51/Cr, /sup 54/Mn, /sup 58/Co, /sup 59/Fe and /sup 60/Co. The method of radioactive tracers was experimentally used for investigating the kinetics of the decontamination and pickling processes, of point corrosion and the composition of the surface layers of steel following diverse types of heat and chemical treatment. (author). 7 figs., 1 tab., 13 refs.

888 (INIS-mf—11312, pp 232-239) **Optimizing soldering technology for nickel alloys.** Mysak, F.; Krejci, M. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

Alpha autoradiography was used to study suitable technology of heat treatment of soldered joints of refractory nickel alloys using boron containing solders. The aim was to locate boron during soldering and subsequent heat treatment and thereby to contribute to the clarification of the impact of the soldering gap, heating time and temperature on joint quality. The reaction /sup 10/B(n,α)/sup 7/Li was used for autoradiography. For alpha detection, dielectric track detectors (plastic foils) were used. The method of alpha radiography showed to be a reliable and relatively cheap method for investigating the distribution of boron in metallic materials and for determining the kinetics of its migration in the process of heat treatment. (Z.S.). 12 figs., 4 refs.

889 (INIS-mf—11312, pp 211-218) **Activation of steel components for radiometric investigation of their corrosion resistance and of corrosion processes.** Silber, R.; Ecksteinova, A. 1987. (In Czech). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88704349/JAW. (CONF-8706308—).

From Application of radionuclide methods in metallurgy and engineering; Vsetin, Czechoslovakia (2 Jun 1987).

The method is described of using the activation of steel components by neutrons in a nuclear reactor for gamma spectrometric investigation of the kinetics of steel dissolution in a liquid corrosion medium. From the kinetic data (time dependence of the amount of dissolved steel components, time dependence of the rate of the dissolution of the different components, or the weight ratio of the dissolved components) it is possible to get an idea of the behavior of the investigated material in the given model corrosion conditions. Also presented are examples of the use of the method of the activation of steel components for investigation of the extraction process of the corrosion of alloy steels, for investigation of the effect of heat treatment on corrosion resistance of alloy steels and for investigation of the course of uneven steel corrosion. (author). 4 figs., 2 tabs.

890 **(JAERI-M—88-130) Ductile fracture behavior of 3-inch diameter carbon steel piping with a circumferential through-wall crack under bending load.** Tyujyo, Noriyuki; Shibata, Katsuyuki; Onizawa, Kunio; Kawamura. Takaichi; Ohba, Toshihiro; Miyazono, Shohachiro. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 125p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755229/JAW.

In order to introduce Leak-Before-Break (LBB) concept into the piping design criteria of the LWR pressure boundary pipings, it is necessary to investigate the pipe fracture behaviors, such as fracture condition and crack opening area, etc. At JAERI, pipe fracture tests of stainless steel and STS42 carbon steel pipes under bending load have been conducted as a part of the LBB research program. This report summarizes the four-point bending test results of 3-inch diameter STS42 carbon steel pipe with a circumferential through-wall crack. Tests were carried out at room temperature. In the tests, the fracture behavior of pipes was investigated to evolute the validity of Net-section collapse criterion, J-R curve and crack opening area. It is shown that the Net-section collapse criterion gives a conservative evaluation for the fracture load of 3-inch diameter carbon steel pipes.

891 **(JAERI-M—88-136) Internal stress during high-temperature creep and activation energy for creep of Hastelloy XR.** Kurata, Yuji; Ogawa, Yutaka. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 18p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755231/JAW.

Creep tests and measurements of internal stress during creep and activation energy for creep were performed at 900 deg C for Hastelloy XR and XR-II developed as heat resistant alloys for high temperature gas cooled reactors. Creep rupture time and steady-state creep rate were influenced by the parameters of boron content, grain size and heat treatment temperature of the alloys. Although the internal stress during creep was also dependent on these parameters, the activation energy for creep was independent on them. It is shown that dependence of the steady-state creep rate on the parameters corresponds to the change in the internal stress. The fact shows the concept of the internal stress is effective to describe steady-state creep behavior of the alloys.

892 **(KFK—4417) Surface analytical investigations of the thermal behaviour of passivated Zircaloy-4 surfaces and of the reaction behaviour of iodine with Zircaloy-4 surfaces.** Kaufmann, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie). Jul 1988. 143p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755422/JAW.

In the first part of the present work the thermal behaviour of atmospherically oxidized Zircaloy-4 samples was investigated at various temperatures. In a next step the amount of iodine adsorbed at the metallic surface was determined as well at room temperature with varying iodine exposures as for constant exposure but varying temperatures. Furthermore, the zirconium iodide species resulting from the interaction of iodine with the Zircaloy-4 and desorbed at higher temperatures were identified by means of residual gas analysis. During these studies it was found that the oxidic overlayer of the passivated Zircaloy-4 samples is decomposed at temperatures above 200/sup 0/C. The iodine uptake at metallic surfaces (cleaned by Ar-ion sputtering) at room temperature slows markedly down after formation of a closed zirconium-iodide overlayer and consequently the further reaction proceeds diffusion-controlled. At 200/sup 0/C ZrI/sub 4/ is formed being the thermodynamically most stable Zr-iodide. During desorption experiments using iodine exposed Zircaloy-4 samples the release of ZrI/sub 4/ was proved. The results obtained from the various experiments are finally discussed with respect to the iodine-induced stress corrosion cracking process and the underlying basic mechanisms and a transport mechanism for the SCC in nuclear fuel rods is proposed.

893 **(LA-UR—88-2660) High temperature interdiffusion and phase equilibria in U-Mo.** Lundberg, L.B. (Los Alamos National Lab., NM (USA)). 1 Aug 1988. Contract W-7405-ENG-36. 19p. (CONF-8809145—1). NTIS, PC A03/MF A01. Order Number DE89000395/JAW.

From Thermodynamics of nuclear materials; Chicago, IL, USA (27 Sep 1988).

Experimental data for interdiffusion and phase equilibria in the U-Mo system have been obtained over the temperature range 1400 to 1525 K as a fallout from compatibility experiments in which UO_2 was decomposed by lithium in closed molybdenum capsules. Composition-position, x-ray diffraction and microstructural data from the interdiffusion zones indicate that the intermediate phase U_2Mo is found in this temperature range, contrary to the currently accepted equilibrium U-Mo phase diagram. The U-Mo interdiffusion data are in good agreement with published values. Inclusion of the U_2Mo phase in a theoretical correlation of interdiffusion and phase equilibria data using Darken's equation indicate that high temperature interdiffusion of uranium and molybdenum follows the usual thermodynamic rules. Significant changes in the value of the thermodynamic based Darken factor near the U_2Mo phase boundary on the high uranium side are indicated from both the new and published interdiffusion data. 9 refs., 10 figs., 3 tabs.

894 **(LA-UR—88-3182) Radiographic studies and hydrocode simulations of two tantalum EFPs [explosively formed penetrators].** Schwalbe, L.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 17p. (CONF-8810171—1). NTIS, PC A03/MF A01. Order Number DE89000315/JAW.

From Tantalm for aerostable EFP's workshop; Picatinny, NJ, USA (18 Oct 1988).

The Army Research Development and Engineering Center (ARDEC) commissioned Los Alamos to provide Honeywell, Inc. with one high- energy flash radiograph for each of two explosively formed penetrators (EFPs) of tantalum. The two axisymmetric warheads were identical in their basic design, but their liner contours were different. The first shot, which we designate as H853, used Honeywell's liner design {number←sign}1; the second shot, H854, used design {number←sign}2. The experiments were planned and directed by J. M. Christian (M-4) and were performed at the Ector radiographic facility (R-306) during the weak of February 22, 1988. Data reduction and analyses were accomplished over the next several months by K. H. Mueller, Jr. (M-4) and L. A. Schwalbe (X-3). In addition to the experimental work, the computations group (X-3) offered to run hydrodynamic code simulations of the EFP formation for the two designs. Some of the results and conclusions of this theoretical work are also presented below. 5 refs., 7 figs.

895 **(LBL—25878) Standard-state gibbs energies of the BCC, HCP, and CCP structures of metals.** Brewer, L. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 17p. (CONF-8807119—1). NTIS, PC A03/MF A01. Order Number DE89000563/JAW.

From CALPHAD XVII: computer coupling of phase diagrams and thermochemistry; Berkeley, CA, USA (10 Jul 1988).

It is common practice to use the stable crystal form of a metal as the standard state for solid solutions and to use the pure liquid as the standard state for liquid solutions. When the deviations from Raoult's Law are small, this is usually the most convenient procedure even when the solid solution has different crystal structure. However, when the deviations are substantial and one is interested in relatively dilute solutions, it is more convenient to use a standard state with the same crystal structure as the solid solution. Thermodynamic data are presented for the pure standard states (Raoult's Law standard states) for stable and metastable structures and for the Henry's Law standard states with the structure of the solid solution. Henry's Law standard states are also given for the liquid. 19 refs., 1 fig., 4 tabs.

896 **(N—88-23893) Compositional redistribution during casting of Hg/sub 0.8/Cd/sub 0.2/Te alloys.** Su, C.H.; Perry, G.L.E.; Szofran, F.R.; Lehoczky, S.L. (National Aeronautics and Space Adminis'ration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1986. 21p. (NASA-TM—101151; NAS—1.15:101151). NTIS, PC A03/MF A01.

A series of Hg(0.8)Cd(0.2)Te ingots was cast both vertically and horizontally under well-defined thermal conditions by using a two-zone furnace with isothermal heat-pipe liners. The main objective of the experiments was to establish correlations between casting parameters and compositional redistribution and to develop ground-based data for a proposed flight experiment of casting of Hg(1-x)Cd(x)Te alloys under reduced gravity conditions. The compositional variations along the axial and radial directions were determined by precision density measurements, infrared transmission spectra, and X-ray energy dispersion spectrometry. Comparison between the experimental results and a numerical simulation of the solidification process of Hg(0.8)Cd(0.2)Te is described.

897 **(N—88-25479) Solid-state combustion synthesis of ceramics and alloys in reduced gravity. Final report.** Valone, S.M.; Behrens, R.G. (Los Alamos National Lab., NM (USA)). Jul 1988. 85p. (NASA-CR—4163; E—4086; NAS—1.26:4163). NTIS, PC A05/MF A01.

Possible microgravity effects are explored in the combustion synthesis of ceramics and alloys from their constituent elements. Molten intermediates are typically present during the combustion process, thereby offering the chance for natural convection to take place. Numerical simulations suggest that the combustion front in concert with gravity may act as a partial zone-refinement mechanism which is attempting to sweep out porosity in the sample. Contrary to suggestions by dimensional analysis, no effects on the combustion rate are seen. An analytical model of the combustion velocity as a function of the gravitational field and the spreading rate of molten material gives the correct order of magnitude of the gravity effect as measured by centrifuge experiments.

898 **(NORDITA—86/9-Prepr.) Foundations of rare earth magnetism.** Mackintosh, A.R.; Moeller, H.B. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Risoe National Lab., Roskilde (Denmark)). (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Risoe National Lab., Roskilde (Denmark)). 1986. 33p. (CONF-860602—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755261/JAW.

From 17. rare earth research conference; Hamilton, Ontario, Canada (8 Jun 1986).

We have worked together intermittently for the last two decades and can therefore present a common viewpoint on the development of the subject during this time. (orig./HSI).

899 **(ORNL/Sub—78-7556/4) Corrosiveness testing of thermal insulating materials: A simulated field exposure study using a test wall.** Sheppard, K.; Weil, R.; Desjarlais, A. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 52p. NTIS, PC A04/MF A01. Order Number DE89001309/JAW.

The corrosiveness of various residential thermal insulation materials was tested under simulated field conditions in a test wall structure. The test was conducted under controlled conditions typical of winter in the absence of a vapor barrier to create relatively severe moisture transport and possible condensation. The house-wall simulation was achieved by constructing a test panel containing 50 compartments into which various insulation materials were installed. The panel was located in an environmental chamber. The test samples included various cellulosic, glass fiber and rockwool insulations as well as sterile cotton as a control. Steel and copper coupons together with water-cooled copper pipes were embedded in the insulation and exposed for 6 months. It was found that moisture absorption by the insulation was the primary factor in causing corrosion but required that chemical activity from insulation components also be present. No corrosion occurred in the absence of insulation or in rockwool and glassfiber insulation. All cellulose insulations caused some corrosion. Mostly this was minimal but in a few cases severe pitting resulted. Such behavior of the cellulose did not correspond to previous laboratory test results in saturated insulation or leachants made from the insulation. However, laboratory testing of leachants made from some of the cellulose after the simulated wall test showed a change in pitting tendency, suggesting that

time and/or exposure to moisture can change the corrosiveness. This should be further explored. 12 refs., 9 figs, 3 tabs.

900 **(ORNL/TM—10852) Advances in iridium alloy processing in 1987.** Heestand, R.L.; Ohriner, E.K.; Roche, T.K. (Oak Ridge National Lab., TN (USA)). Aug 1988. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01. Order Number DE89001147/JAW.

A new process for the production of DOP-26 iridium alloy blanks is being evaluated and optimized. The alloy is prepared by electron-beam (EB) melting of Ir-0.3% W powder compacts followed by doping with aluminum and thorium by arc melting. Drop-cast alloy rod segments are EB welded to produce an electrode that is consumable arc melted to produce an ingot for extrusion and subsequent rolling. Initial results showed rejections for ultrasonic indications of alloy blanks produced by this process to be very low. Subsequently, some ingots have exhibited delaminations in the sheet, leading to rejection rates similar to that obtained in the standard process. The increase in delaminations is related to near-surface porosity in the consumable arc-melted ingot. A number of modifications to the arc-melting process and plans for further experimental work are described. In addition, the tensile properties of the DOP-26 iridium alloys have been measured over a range of test temperatures and strain rates. A laboratory evaluation of alternative cleaning procedures indicates that electrolytic dissolution of DOP-26 iridium alloy in an HCl solution is a potential substitute to the KCN process now in use. 7 refs., 13 figs., 6 tabs.

901 **(PB—88-235239/XAB) Development of surface-modification method by ion beam for enhanced oxidation resistance. Final report on Phase 1, 8 March-7 September 1985.** Srinivasan, V. (Universal Energy Systems, Inc., Dayton, OH (USA)). Sep 1985. 110p. NTIS, PC A06/MF A01.

For oxidation study, an e-beam deposited layer of Pt of thickness 150A was mixed with the substrate by a fluence of 5 quadrillion Pt^+/sq. cm, while Y, 180 KeV was implanted directly. Codep coating was applied to the bare and surface-modified coupons. Isothermal oxidation tests at 1000C and cyclic oxidation tests of 1 hr. cycle between 1000C and RT were performed on coupons with different surface conditions up to 500 hours and the oxidation kinetics was followed by gravimetric measurement. Ion beam mixing was studied by Rutherford backscattering (RBS) and Auger sputter profiling. Scanning electron microscope, EDAX and RBS were used to characterize the oxide scales. Under the test conditions, Y implantation improves the cyclic oxidation resistance of Rene N4 significantly and this improvement is comparable to the oxidation resistance of codep coating. The results of the research can be applied to developing effective commercial oxidation protection methods for jet engine blades and vanes.

902 **(PNL-SA—15717) Near-surface chemistry and corrosion behavior of excimer laser surface-melted AISI type 304 stainless steel.** Baer, D.R.; Frydrych, D.J.; Jervis, T.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 12p. (CONF-880901—5). NTIS, PC A03/MF A01. Order Number DE89001485/JAW.

From Metallurgical Society fall meeting and American Society for Metals materials week; Chicago, IL, USA (24 Sep 1988).

The effects of excimer laser surface melting on the near-surface chemistry and corrosion behavior of AISI 304 stainless steel have been examined as a function of total energy deposited on the specimen. The surface chemistry resulting from the laser treatments has been examined using Auger electron spectroscopy. Electrochemical methods were used to monitor the corrosion behavior of the specimens in deaerated 0.1 M NaCl. Electron microscopy was used to characterize the extent of local corrosion of the specimens. Laser treatment was observed to increase the chromium concentration of the surface oxide and to reduce the number of pits. Two types of pits were observed on untreated material, but only one type of pit occurred after laser treatment. 7 refs., 6 figs.

903 **(RISO-R—561) Metallurgy Department annual progress report for 1987.** Schroeder Pedersen, A.; Bilde-Soerensen, J.B.; Hansen, N. (eds.). (Risoe National Lab., Roskilde (Denmark)). May 1988. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755131/JAW.

Selected activities of the Metallurgy Department at Risoe National Laboratory during 1987 are described. The work is presented in four chapters: Materials Science, Materials Engineering, Materials Technology and Energy Programmes. A survey is given of the Department's participation in international collaboration and of its activities within education and training. Furthermore, the main numbers illustrating the Departments's economy are given. Lists of staff members, visiting scientists, publications, lectures and poster presentations are included. 38 ills.

904 **(SAND—88-936C) The effect of chemistry modifications on the solidification behavior and weldability of Alloy 625.** Cieslak, M.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-8810176—1). NTIS, PC A02/MF A01. Order Number DE89001046/JAW.

From JOWOG 22D joining subgroup; Aldermasten, UK (4 Oct 1988).

The purpose of this study was to examine the effect of chemistry variations on the solidification behavior and weldability of Alloy 625. As the effect of several tramp elements (i.e., S, P, etc.) could be predicted a priori, the experimental alloy design excluded these elements as factors. A 3-factor, 2-level, full fractorial experimental design was examined with the elements Nb(0 wt%, 3.5 wt%), C(0.005 wt.%, 0.035 wt.%), and Si(0.01 wt.%, 0.40 wt.%) being chosen to fill the design matrix. Compositions of the alloys studied are listed. These compositions were prepared using VIM/VAR techniques in the Sandia National Laboratories Melting and Solidification Facility. Conventional hot and cold working techniques were used to produce 3 mm thick sheet for Varestraint weldability testing. Differential thermal analysis (DTA) was used to establish significant solidification temperatures and reactions. Greater experimental detail has been given previously. 2 refs., 2 figs., 2 tabs.

905 **(SAND—88-0935C) Consequences of Nd:YAG laser welding Al-Mg and Al-Mg-Si alloys.** Cieslak, M.J.; Fuerschbach, P.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-8810176—3). NTIS, PC A02/MF A01. Order Number DE89001047/JAW.

From JOWOG 22D joining subgroup; Aldermasten, UK (4 Oct 1988).

Aluminum alloys 6061, 5456, and 5086 were fusion welded with both pulsed and continuous wave Nd:YAG laser processing. Continuous welds were made with a Holobeam 6-head, 600 watt laser operated at full power (~ 675 watts). The pulsed welds were made with a Raytheon SS-501-7,400 watt laser operated at 180 watts average power. The experimental details have been reported previously. The purpose of the work was to characterize the effect of Nd:YAG laser welding on the soundness (hot-cracking susceptibility), fusion zone chemistry modification by preferential vaporization of volatile elements, and mechanical response (hardness) of these alloys. 5 refs., 3 figs.

906 **(SAND—88-0937C) Pulsed Nd:YAG laser welding of titanium aluminide.** Cieslak, M.J.; Headley, T.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-8810176—2). NTIS, PC A02/MF A01. Order Number DE89001048/JAW.

From JOWOG 22D joining subgroup; Aldermasten, UK (4 Oct 1988).

Titanium aluminides are an interesting new class of intermetallic alloys having useful strength-to-weight ratios for a variety of military and aerospace applications. In particular, the alloys based upon the ordered hexagonal (α_2, DO_{19}) compound, Ti_3Al, are finding applications in some present aerospace designs. In the present study we examine the response of the Ti_3Al derivative ternary alloy Ti-24Al-11Nb (at. %) to pulsed Nd:YAG laser welding from the perspective of bend ductilities and evolution of microstructure. This

alloy was processed as 1.7 mm thick sheet having a microstructure of matrix α_2 (~ 95%) and intergranular β (body-centered-cubic). A Raytheon SS-501-7 pulsed Nd:YAG laser welding system was used. Samples were predominantly bead-on-plate welds made in an argon atmosphere (<0.1 ppM O_2) glovebox at 200 watts average power with a 10 Hz pulse frequency. Greater experimental detail has been reported previously. 3 refs., 2 figs.

907 **(SAND—88-1475C) Undercooling and glass formation in pulsed-laser melted γ-TiAl.** Perepezko, J.H.; Follstaedt, D.M.; Peercy, P.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-881155—1). NTIS, PC A02. Order Number DE88016745/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

Pulsed laser irradiation of a metallic surface is perhaps the most effective method available for generating ultrarapid liquid quench rates. Associated with the high quench rate is a rapid resolidification as the liquid-solid interface is driven back to the surface upon termination of the laser pulse. Since the unmelted substrate is an excellent heat sink, the movement of a melting temperature isotherm across the near surface is extremely rapid with rates approaching 100 m/s. The velocity of the solidification front, V, in response to the rapid heat transport is governed by the frequency of net atom transfer from the liquid configuration to the crystalline solid configuration. For pure components and dilute single-phase alloys, solidification is believed to be collision limited so that it proceeds as fast as required for the heat flow. In concentrated alloys with solidification into multiple solid phases, diffusional redistribution of solute limits the resolidification rate to far below the collision-limited range. In this case, the liquid can be undercooled to well below the equilibrium solidification temperature, which permits metastable phase nucleation or glass formation. With diffusion-limited resolidification, pulsed laser annealing can be used to access a number of microstructural options. 14 refs., 2 figs.

908 **(UCRL—99349) Observations of dislocation interactions with recrystallized grain boundaries.** Price, C.W. (Lawrence Livermore National Lab., CA (USA)). 5 Aug 1988. Contract W-7405-ENG-48. 9p. (CONF-880841—22). NTIS, PC A02/MF A01. Order Number DE89001356/JAW.

From MAS/EMSA microbeam analysis conference; Milwaukee, WI, USA (7 Aug 1988).

Possible evidence of the interaction of individual dislocations with recrystallized grain boundaries (GBs) was found in aluminum specimens that had been statically recrystallized after hot deformation. Matrix dislocations from the deformed material appeared to terminate on the recrystallized GB; however, GB dislocations (GBDs) that should have formed from the absorption of the matrix dislocations were not present. In addition, subboundary structure immediately in front of the moving GB appeared to have undergone accelerated dissociation. These observations suggest that rapid GB motion is not associated with lateral movement of GBDs, and short-range dislocation-GB interaction forces, probably image forces, could cause climb-induced vacancy supersaturations to form in front of the GB. This supersaturated vacancy atmosphere could constitute an important contribution to rapid GB migration. 20 refs., 2 figs.

909 **(UCRL—99716) Reactive-element effect studied using ion implanation.** King, W.E.; Grabowski, K.S. (Lawrence Livermore National Lab., CA (USA); Naval Research Lab., Washington, DC (USA)). Sep 1988. Contract W-7405-ENG-48. 23p. (CONF-880901—2). NTIS, PC A03/MF A01. Order Number DE89001456/JAW.

From Metallurgical Society fall meeting and American Society for Metals materials week; Chicago, IL, USA (24 Sep 1988).

Implantation of metals that form chromia layers upon exposure to high temperature oxidizing environments with reactive element ions has a very large effect on the growth rate of the oxide and adhesion of the oxide to the base alloy. We have investigated the effect of Y ion implantation on the high temperature oxidation of Fe-24Cr using Rutherford backscattering spectroscopy, secondary ion mass spectroscopy, and electron microscopy. Analytical tools have been applied to determine the spatial distribution of Y, the microstructure of the oxide, and contribution of oxygen transport to the oxidation process. Results are compared with similar experiments in Fe-Cr alloys with Y additions and with results of cation and anion tracer diffusion experiments. 50 refs., 19 figs., 3 tabs.

910 **Magnetization reversal in nucleation controlled magnets. I. Theory.** Ramesh, R.; Srikrishna, K. (Department of Materials Science and Mineral Engineering and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **64**: No. 11, 6406-6415(1 Dec 1988).

A statistical model, based upon earlier models of Brown [J. Appl. Phys. 33, 3022 (1962)] and McIntyre [J. Phys. D 3, 1430 (1970)] has been developed to examine the magnetization reversal of domain-wall nucleation controlled permanent magnets such as sintered Fe-Nd-B and $SmCo_5$. Using a Poisson distribution of the defects on the surface of the grains, a "weakest link statistics" type model has been developed. The model has been used to calculate hysteresis loops for sintered Fe-Nd-B-type polycrystalline magnets. It is shown that the intrinsic coercivity measured for a bulk magnet should vary inversely as the logarithm of the surface area of the grain. The effect of demagnetizing field has been incorporated by a mean-field-type approximation, to calculate the overall nucleation field from the intrinsic coercivity. The hysteresis loops theoretically calculated are in excellent agreement with the overall form of those experimentally determined for similar nucleation controlled magnets. The model also predicts that for an inhomogeneous grain size distribution, such as a bimodal distribution, kinks will be observed in the second quadrant of the hysteresis loops.

911 **Magnetization reversal in nucleation controlled magnets. II. Effect of grain size and size distribution on intrinsic coercivity of Fe-Nd-B magnets.** Ramesh, R.; Thomas, G.; Ma, B.M. (Department of Materials Science and Mineral Engineering and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **64**: No. 11, 6416-6423(1 Dec 1988).

Results of experiments to study the effect of grain size and grain-size distribution on the intrinsic coercivity and the hysteresis loop of sintered Fe-Nd-B magnets are presented. It is shown that the intrinsic coercivity decreases as the average grain size of the magnet is increased. It is also shown that the intrinsic coercivity decreases linearly with the logarithm of the square of the grain size. This is consistent with the predictions made based upon the statistical model developed in Part I. An increase in the sintering temperature leads to an increase in the average grain size, which consequently leads to a narrower hysteresis loop and lower intrinsic coercivity compared to magnets sintered at a lower temperature. It is also shown that a heterogeneous grain-size distribution, such as a bimodal distribution, causes kinks to appear in the second quadrant of the hysteresis loop. By examining magnets with different fractions of large grains, the prediction that the magnitude of the kinks increases with the volume fraction of the large grains, has been verified experimentally.

912 **Phase formation in the Pd-InP system.** Caron-Popowich, R.; Washburn, J.; Sands, T.; Kaplan, A.S. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Applied Physics;* **64**: No. 10, 4909-4913(15 Nov 1988).

The interaction of 40-nm Pd layers on chemically cleaned (100) InP substrates has been examined. The samples were isochronally annealed in an Ar-5%H_2 ambient at temperatures from 175 to 650 °C. Transmission electron microscopy, x-ray diffraction, and Auger electron spectroscopy were used to study the phases that formed. The reaction began upon deposition. With subsequent annealing at 175 °C, an amorphous ternary phase of approximate composition Pd/sub 4.8/InP/sub 0.7/ was formed. For samples annealed at 215 and 250 °C, the tetragonal ternary phase, Pd_8InP (a = 0.3928 nm, c = 0.6917 nm), was found. After higher-temperature annealing (45—650 °C), the simple cubic phase PdIn (a = 0.326 nm), was observed.

913 **Hydrogen local modes and phonon dispersion in LuD/sub 0.19/ and Lu.** Blaschko, O.; Krexner, G.; Pintschovius, L.; Vajda, P.; Daou, J.N. (Institut fuer Experimentalphysik der Universitaet Wien, Strudlhofgasse 4, A-1090 Wien, Austria). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9612-9615(15 Nov 1988).

The phonon dispersion of both pure Lu and α-LuD/sub 0.19/ is determined along the symmetry directions Γ-A and Γ-K-M. The phonon energies are partly found to increase due to hydrogen absorption. At low temperatures no influence of deuterium ordering on the phonon frequencies can be detected. Furthermore, the hydrogen local-mode properties are investigated in α-LuD/sub 0.19/. In accordance with recent results on α-YH(D)/sub 0.18/, the potential at the hydrogen site is found to be very anisotropic.

914 **Polar Kerr-effect observation of perpendicular surface anisotropy for ultrathin ferromagnetic films: fcc Fe/Cu(100).** Liu, C.; Moog, E.R.; Bader, S.D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **64**: No. 10, 5325-5327(15 Nov 1988).

The theoretically predicted prependicular surface anisotropy of ultrathin ferromagnetic Fe films has been confirmed using the magneto-optical Kerr effect. Polar and longitudinal Kerr-effect measurements have been performed in situ on the same fcc Fe/Cu(100) films to study the dependence of the magnetic properties on film thickness and growth temperature conditions. Auxiliary LEED and Auger studies are used to characterize the structure and growth of the films. For films 1.2—5.9 monolayers (ML) thick grown at ~100 K, for instance, square hysteresis-loop behavior in the polar Kerr effect confirmed the dominance of the perpendicular surface anisotropy. Examples are presented to document how the polar and longitudinal Kerr-effect signals evolve for films thicker than 6 ML due to the easy axis reorienting into the film plane. To differentiate between intrinsic temperature effects and those associated with interfacial compositional changes, the films were thermally cycled and their Kerr signals monitored. Films of thickness around 4 ML retained their characteristic polar Kerr-effect square loops despite thermal cycling between ~100 and ~400 K, while those <2 ML thick changed irreversibly. These studies confirm that intermixing can be limited to the monolayer range by low-temperature growth conditions, but the LEED results show that the degree of structural ordering of the films is reduced, as expected.

915 **Barkhausen effect and discontinuous magnetostriction in Terfenol-D.** Jiles, D.C.; Ostenson, J.E.; Owen, C.V.; Chang, T.T. (Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **64**: No. 10, 5417-5418(15 Nov 1988).

Measurements of magnetostriction λ, magnetic Barkhausen effect (MBE), and magnetic induction B have been made as a function of magnetic field H in a number of specimens of Tb/sub 0.3/Dy/sub 0.7/Fe/sub 1.9/ prepared recently at Ames Laboratory. These results showed marked variations in properties from specimen to specimen. For example, the saturation magnetostriction of the materials under a compressive load of 14 MPa (2000 psi) varied from 1500 to 2200 x 10/sup -6/. However, it was noticed that in the high-performance, high-magnetostriction specimens a common feature was a very rapid change in magnetostriction with field in the range 400—500 Oe. Barkhausen measurements taken on two extreme specimens from the group also revealed very different signals, in particular the high-performance material was found to have a distinctive double peak in Barkhausen activity, one peak of which corresponded to the rapid change in magnetostriction, while the other occurred at the flat region of the magnetostriction versus field curve, corresponding to little or no change in magnetostriction.

916 **Scaling of the magnetoresistance of UBe_{13} under pressure.** Willis, J.O.; McElfresh, M.W.; Thompson, J.D.; Smith, J.L.; Fisk, Z. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **64**: No. 10, 5613-5615(15 Nov 1988).

We report magnetoresistance measurements of the heavy electron compound UBe_{13} above the superconducting transition temperature T/sub c/ and below 4 K for pressures P up to 19 kbar and for magnetic fields H up to 9 T. We observe strong negative magnetoresistance at all pressures and temperatures. The resistivity rho is quadratic in temperature T from T/sub c/ up to a maximum temperature of 1 K at 1 bar increasing to 2 K at 19 kbar. The slope of the T^2 term decreases with both H and with P. We find that δ(H)equivalent-[rho(H)-rho(0)]/rho(0) for a given pressure scales as a function of H/T and exhibits power-law behavior over one decade with an exponent of 1.7. In addition, δ(H) at high pressure shows this same power law over a more limited H/T range.

917 **Temperature dependence of interface anisotropy in Ni/Mo multilayers.** Pechan, M.J. (Department of Physics, Miami University, Oxford, Ohio 45056). *Journal of Applied Physics;* **64**: No. 10, 5754-5756(15 Nov 1988).

Equal layer thickness Ni/Mo multilayer samples ranging in Ni layer thickness d from 14 to 340 A have been investigated by x-band ferromagnetic resonance at temperatures between 4 and 293 K. The dependence of anisotropy (less demagnetization) H/sub a/ upon d clearly indicates the interface anisotropy plays a significant role in these samples. Interface (K/sub s/) and volume (K/sub v/) contributions to the anisotropy are extracted at each temperature using an approximate form of H/sub a/ = 2(K/sub v/+2K/sub s//d)/M. The K/sub s/ temperature dependence is shown to be inconsistent with a simple mean field model and indicates that interface strain due to the Ni-Mo lattice mismatch is largely responsible for the origin of K/sub s/.

918 **High coercivities in as-cast Nd-Fe and Nd-Fe-Ti alloys.** Tsoukatos, A.; Strzeszewski, J.; Hadjipanayis, G.C. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). *Journal of Applied Physics;* **64**: No. 10, 5971-5973(15 Nov 1988).

Bulk $Nd_{73}Fe_{27}$ and Nd/sub 66.8/Fe/sub 24.7/Ti/sub 8.5/ alloys exhibit relatively high coercivities with a room-temperature value of about 5 kOe. The origin of the high coercivities has been investigated with magnetic and structural studies. Thermomagnetic data show the presence of a magnetic phase with a Curie temperature of about 270 °C which is close to that of $NdFe_2$. This phase is metastable changing to a magnetic phase with an ordering temperature of 65 °C after heating to 700 °C. The lower Curie temperature phase is related to Nd_2Fe_{17}. The coercivity of the sample decreased to negligible values after the heat treatment. It is believed that the high coercivities are due either to the anisotropic $NdFe_2$ phase or possibly to an oxygen-stabilized Nd-Fe-O phase which is probably present in the form of fine particles.

919 **Unoccupied band structure of the Nb(110) surface.** Johnson, P.D.; Pan, X. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9447-9450(15 Nov 1988).

Inverse-photoemission spectra (IPES) recorded from Nb(110) allow the unoccupied bands to be mapped. The critical points are identified and the approximate form of the high-lying Σ_1 band established. This latter band serves as the initial state in IPES and the final state in photoemission studies. It is suggested that disagreement between theory and experiment for the T/sub 25'/sub 1/ critical point probably reflects the presence of a surface resonance. Fluorescence is also observed from the decay of the Nb 4p core holes. The relative intensity of the fluorescence due to 4p/sub 3/2/ and 4p/sub 1/2/ core holes is discussed in terms of possible Coster-Kronig transitions.

920 **Adsorption of antimony on Au(001).** Wertheim, G.K.; Rowe, J.E.; Buchanan, D.N.E.; Polite, H.L.; Shigekawa, H. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974-2070). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9606-9611(15 Nov 1988).

Antimony overlayers on a clean Au(001) surface were prepared by surface segregation on a sputtered and annealed, Sb-doped gold single crystal. Valence-band photoemission data, taken with photon energies between 35 and 150 eV, exhibit a Sb 5p contribution at the Fermi energy at the higher photon energies. Core-level photoemission data yield surface-atom shifts for the Au 4f core electrons of +0.44 and +0.90 eV, opposite in sign to that of the

clean Au surface, and suggestive of loss of charge from the Au surface layer. Sb 4d core-level spectra have the asymmetric line shape associated with metallic screening with a many-body singularity index of 0.08. This value is significantly larger than that of bulk gold, and suggests screening by electrons in Sb-derived states at the Fermi level. All aspects of these measurements indicate that the Sb is strongly chemisorbed and probably forms an ordered surface alloy. The reconstruction of the Sb-covered surface was investigated by low-energy electron diffraction, and showed a compressed hexagonal layer with 4 x 22 periodicity, which fits a modified (111) double layer of $AuSb_2$ with a small number of additional reconstructed Au atoms.

921 **Relativistic effects on the surface electronic structure of Mo(011).** Jeong, K.; Gaylord, R.H.; Kevan, S.D. (Department of Physics and Materials Science Institute, University of Oregon, Eugene, Oregon 97403). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 15, 10302-10312(15 Nov 1988).

High-resolution photoemission studies of the Mo(011) surface have allowed us to isolate and to study the effects of the spin-orbit interaction on the surface electronic structure of Mo(011). We have observed and characterized three distinct phenomena, all related to the breaking of symmetry by the spin-orbit interaction. The first is a zone-center surface resonance which exists in a pseudogap between the bulk Γ/sub 8+/ and the Γ/sub 7+/ points, and is similar to one observed previously on W(011). We also have observed a surface state in a projected band gap opened by spin-orbit-induced hybridization between bulk bands at N-bar. Finally, we have observed avoided crossings of surface bands along the symmetry azimuths. These bands would be of opposite mirror-plane symmetry in the absence of the spin-orbit interaction, but hybridize under its influence. The transfer of both the polarization behavior and contamination sensitivity from one band to another is observed and characterized. We speculate on the relevance of these results to other surface properties, including reconstruction and work-function change.

922 **Flicker (1/f) noise in copper films due to radiation-induced defects.** Pelz, J.; Clarke, J.; King, W.E. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 15, 10371-10386(15 Nov 1988).

Changes were measured in the resistivity and 1/f noise in polycrystalline Cu films due to defects induced by 500-keV to 1.1-MeV electron irradiation or 1-MeV Kr^+-ion irradiation. Irradiation with 500-keV electrons increased the noise level in films maintained at 90 K by as much as an order of magnitude, while the resistivity increased by at most 10%. When the films were annealed at progressively higher temperatures, both the 1/f noise and the resistivity were reduced; however, at lower annealing temperatures, the fractional reduction in the induced noise was substantially more than in the added resistivity. These results suggest that a large fraction of the induced noise is generated by "mobile" added defects that are more readily annealed than the majority of the added defects. The temperature dependence of the noise after irradiation and partial annealing indicated that the induced noise was thermally activated in a manner consistent with the Dutta-Dimon-Horn model. Isolated defects created by 1.1-MeV electron irradiation were found to produce substantially higher noise levels than clustered defects resulting from 1-MeV Kr^+ ion irradiation. Measurements on a number of films indicate that the induced 1/f noise is not sensitive to the type and quantity of interstitial traps. A model which attributes the noise to the motion of defects involving vacancies close to surfaces, grain boundaries, or dislocations is most consistent with the experimental results.

923 **Electronic structure of Fe, Co, and Ni impurities in Pd.** van Acker, J.F.; Weijs, P.W.J.; Fuggle, J.C.; Horn, K.; Wilke, W.; Haak, H.; Saalfeld, H.; Kuhlenbeck, H.; Braun, W.; Williams, G.P.; and others. (Research Institute of Materials, University of Nijmegen, Toernooiveld, 6525 ED Nijmegen, The Netherlands). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 15, 10463-10467(15 Nov 1988).

A photoemission study of the valence bands of the dilute alloys PdFe, PdCo, and PdNi is presented. We use the Cooper minimum effect to estimate the local density of states on the impurity site. The behavior of transition-metal impurities in a transition-metal matrix is shown to be very different from their behavior in s-p metals. Our conclusion is that the Fe and Co 3d states are mixed with states throughout the Pd 4d band, while the Ni contribution to the spectra is dominated by a peak of (minority) 3d states near the Fermi level.

924 **Vibrational properties of amorphous silicon-germanium alloys and superlattices.** Bouchard, A.M.; Biswas, R.; Kamitakahara, W.A.; Grest, G.S.; Soukoulis, C.M. (Microelectronics Research Center, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 15, 10499-10506(15 Nov 1988).

Densities of states and localization characteristics have been calculated for vibrational modes in a-Si/sub x/Ge/sub 1-//sub x/ alloys and a-Si/a-Ge superlattices, using amorphous tetrahedral networks generated by molecular-dynamics methods. For the alloys, the calculated densities of states agree very well with Raman scattering experiments at all concentrations $0 \leqq x \leqq 1$. We explicitly show that an x-dependent feature at 390 cm/sup -1/ arises primarily from Si-Ge bond-stretching motions. The localization of vibrational modes is enhanced in magnitude and in frequency range for the alloys as compared with the pure amorphous materials, but extended modes are still present at all x. To account for the Raman measurements on thin a-Si/a-Ge superlattices, a mixed Si-Ge interfacial region about 5 A in thickness is indicated by our calculations.

925 **Two-dimensional compressibility of electrochemically adsorbed lead on silver (111).** Melroy, O.R.; Toney, M.F.; Borges, G.L.; Samant, M.G.; Kortright, J.B.; Ross, P.N.; Blum, L. (IBM Almaden Research Center, 650 Harry Road, San Jose, California 95120). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 15, 10962-10965(15 Nov 1988).

We report the two-dimensonsal compressibility of electrochemically deposited lead on silver (111). Measurements were made in situ (in contact with solution) using grazing incidence x-ray scattering. Between monolayer formation and bulk deposition, the near-neighbor distance of the lead monolayer decreases linearly with applied potential. Since the lead monolayer is in equilibrium with the lead in solution, the isothermal compressibility of the monolayer can be calculated and is 0.98 A^3/eV. This is in good agreement with that of a two-dimensional, free-electron gas.

926 **Neutron irradiation study of Nd-Fe-B permanent magnets made from melt-spun ribbons.** Brown, R.D.; Cost, J.R.; Meisner, G.P.; Brewer, E.G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **64**: No. 10, 5305-5307(15 Nov 1988).

Radiation-induced changes in the magnetization of sintered Nd-Fe-B permanent magnets are known to vary widely among specimens produced by different manufacturers. Samples of Nd-Fe-B MAGNEQUENCH magnets, which are made from melt-spun ribbons, have not been studied and show a much reduced sensitivity to neutron irradiation than do sintered Nd-Fe-B magnets. All melt-spun ribbon-based MAGNEQUENCH magnets, i.e., epoxy-bonded, hot-pressed, and die-upset magnets, show essentially the same slow decrease in magnetic remanence with neutron dose. Measurements of the open-circuit remanence B/sub r//B/sub r// sub /0 at various times during the irradiation show a decay of only 1.5% of the preirradiated value for the MAGNEQUENCH magnets after 1 h of irradiation, or a dose of 1.4×10^{16} neutrons/cm^2, compared to a 4.6% drop in remanence for the best sintered Nd-Fe-B magnet (Sumitomo 30H) with the same irradiation dose. Moreover, after 5.3 h of irradiation, the remanence drops by only 3% for the MAGNEQUENCH magnets. Magnets made from melt-spun ribbons are thus the least sensitive to neutron irradiation so far measured for Nd-Fe-B permanent magnets, but are somewhat more sensitive than samarium-cobalt magnets.

927 **Incommensurate phases in barium sodium niobate: Transmission-electron-microscopy study.** Barre, S.; Mutka, H.; Roucau, C. (Laboratoire d'Optique Electronique du Centre National de la Recherche Scientifique, Boite Postale 4347, 31055 Toulouse Cedex, France). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 9113-9119(1 Nov 1988).

A transmission-electron-microscopy study of barium sodium niobate has confirmed new features of the incommensurate phase. We present here images showing the nucleation of the incommensurate phase when the temperature increases after thermal cycling the sample or annealing in the incommensurate phase. In agreement with previous inferences, in situ annealing either at 230 °C near the lock-in transition or at 270 °C close to the tetragonal normal phase transition can favor the stability of a unidirectional 1q or a doubly modulated 2q incommensurate phase, respectively. The difference in the orientation of discommensurations, either perpendicular to the orthorhombic a axis or perpendicular to the tetragonal a and b axes, agree with an assignment of the two phases based on theoretical arguments and on x-ray and optical data.

928 **Accurate calculations of 3p and 3d lifetimes in the Na sequence.** Theodosiou, C.E.; Curtis, L.J. (Department of Physics and Astronomy, The University of Toledo, Toledo, Ohio 43606). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4435-4445(1 Nov 1988).

Computed lifetimes for the 3p ^{2}P/sub 1/2/, P3p^{2}P/sub 3/2/, 3d ^{2}D/sub 3/2/, and 3d^{2}D/sub 5/2/ levels in the sodium isoelectronic sequence are presented for Z = 11—54, 74, 79, 90, and 92. These calculations agree well with recent high-precision lifetime measurements, and conflict with some ab initio estimates which indicated lifetimes shorter than those experimentally observed. Our calculations involve the inclusion of experimental energy-level data and the use of a realistic model potential, which utilizes comprehensive spectroscopic measurements that have recently become available. We also demonstrate that the core-polarization effects are significant and must be included to obtain agreement with experiment. As part of the study, we used the existing data base and Dirac-Fock methods to determine new values for ionization potentials in this sequence.

929 **EPR of Gd/sup 3+/-doped single crystals of LiY/sub 1-//sub x/Yb/sub x/F_4.** Misiak, L.E.; Misra, S.K.; Mikolajczak, P. (Physics Department, Concordia University, 1455 de Maisonneuve Blvd. West, Montreal, Quebec, Canada H3Gchemical bond1M8). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8673-8682(1 Nov 1988).

Extensive X-band EPR measurements have been carried out on Gd/sup 3+/-doped single crystals of LiY/sub 1-//sub x/Yb/sub x/F_4 (x = 0.0, 0.1, 0.2, 0.3, 0.4, 0.6, 0.8, 1.0), covering the temperature range 4.2—290 K. The spin-Hamiltonian parameters (SHP) are evaluated by the use of a rigorous least-squares fitting procedure. The systematics of the SHP are studied both as functions of x and of temperature. Newman's superposition model has been applied to the calculation of SHP; it is found that the calculated values agree quite well with the experimental values, provided that one considers minor distortions of the positions of the eight fluorine ions surrounding the Gd/sup 3+/ ion. The temperature variation of SHP has been explained to be predominantly due to spin-phonon interaction and partially due to thermal expansion of the crystal lattice. Finally, the average Gd/sup 3+/-Yb/sup 3+/ exchange interaction, averaged over the nearest and next-nearest neighbors, has been estimated, in LiY/sub 0.9/Yb/sub 0.1/F_4, to be 3.8 +- 2.5 GHz, as found by the application of the molecular-field model using the g shift from the isostructural diamagnetic host, $LiYF_4$, at liquid-helium temperature.

930 **Effect of extra Cu on ordering kinetics in thin films of Cu_3Au.** Shannon R.F. Jr.; Harkless, C.R.; Nagler, S.E. (Department of Physics, University of Florida, Gainesville, Florida 32611). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 9327-9330(1 Nov 1988).

Time-resolved x-ray scattering has been used to study ordering kinetics in sputtered films of Cu_3Au. The samples were annealed at high temperatures, then quenched to fixed temperatures below the order-disorder transition temperature. Domain coarsening observed in stoichiometric films is consistent with curvature-driven growth. Domain growth in films of Cu/sub 0.79/Au/sub 0.21/ proceeds much more slowly. The results suggest that the extra copper has the same effect on the ordering kinetics as a diffusive impurity, resulting in domain sizes growing logarithmically with time.

931 **Effect of excimer laser alloying of Ti on the sliding friction of AISI 304 stainless steel.** Jervis, T.R.; Hirvonen, J.; Nastasi, M. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87544). *Journal of Materials Research;* **3**: No. 6, 1104-1107(Nov 1988).

Dry sliding friction measurements made on titanium layers evaporated on AISI 304 stainless steel in the as-deposited and excimer laser mixed form show a dependence on the film thickness and the amount of mixing. The effect of laser mixing is dependent on the incident fluence with high fluences and/or large numbers of pulses producing surfaces with poor frictional properties. The optimum total fluence depends on the thickness of the surface layer, a result consistent with thorough mixing of the alloyed layer without the surface damage that results from large numbers of pulses.

932 **Microstructure and fracture toughness of powder-processed Al_3Nb.** Schneibel, J.H.; Becher, P.F.; Horton, J.A. (Oak Ridge National Laboratory, P. O. Box 2008, Oak Ridge, Tennessee 37831-6116). *Journal of Materials Research;* **3**: No. 6, 1272-1276(Nov 1988).

Intermetallic alloys with the nominal compositions Al—24.5Nb, Al—25Nb, and Al—25.5Nb (at.%) were fabricated by hot-pressing of pre-alloyed powders in graphite dies in vacuum. The hot-pressed disks contained substantial porosity even at processing temperatures of 0.95 T/sub m/, where T/sub m/ is the absolute melting point. In addition to some copper and silicon contamination, significant concentrations of oxygen and carbon were measured in Al—25.5Nb. Alpha alumina precipitates as well as niobium-enriched precipitates were identified. The fracture toughness of precracked bend specimens with the nominal composition Al—25.5Nb was found to be 2.5 +- 0.5 MPa m^1/sup //^{2}. Possibilities for improving this value are discussed.

933 **Fast diffusion and nucleation of the amorphous phase in Ni—Zr films.** Ehrhart, P.; Averback, R.S.; Hahn, H.; Yadavalli, S.; Flynn, C.P. (University of Illinois—Urbana—Champaign, Urbana, Illinois 61801). *Journal of Materials Research;* **3**: No. 6, 1276-1278(Nov 1988).

The nucleation of the amorphous phase by solid-state reactions has been investigated on single-crystal Zr films grown by molecular beam epitaxy and covered in situ with either polycrystalline Ni, amorphous (a-) NiZr, or single-crystalline $Zr_{99}Ni_{01}$ films. Interfacial reactions were investigated by backscattering analysis or secondary ion mass spectroscopy. The amorphizing reaction occurred only in the specimen with the a-NiZr overlayer, although fast Ni diffusion through the single-crystalline Zr layer was observed in all three specimens. The nucleation behavior of a-NiZr is attributed to the combination of high-Ni and low-Zr mobility in crystalline Zr.

934 **Material test machine for tension-compression tests at high temperature.** Cioletti, O.C. (to Dept. of Energy, Washington, DC). US Patent 4,762,003. 9 Aug 1988. Filed date 1 May 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes an apparatus for testing the properties of a material specimen, comprising in combination: a test chamber including means for mounting a test specimen therein; actuator means coupled to the specimen located in the test chamber through a load column, the load column being further comprised of a pull rod and force transducer means serially coupled between the actuator means and the test specimen, and a force balance chamber through which the pull rod passes, located externally of the test chamber and including means responsive to the pressure inside of the test chamber and acting on the pull rod to counteract the pressure or force inside of the test chamber tending to eject the pull rod therefrom. The test chamber comprises an autoclave, wherein the force balance chamber includes a piston chamber, a piston

member within the piston chamber, and means for coupling the pressure inside of the autoclave to one side of the piston member, wherein the piston member comprises a portion of the pull rod, and wherein the means for coupling pressure comprises a longitudinal bore in the pull rod and at least one through-hole in the pull rod from the bore to the piston chamber.

935 **(N—88-25518) Effect of Zr or Cr content on the fracture toughness of the high purity Al-Zn-Mg alloys.** Kato, E.; Ueda, Y.; Mori, H. (National Aeronautics and Space Administration, Washington, DC (USA)). Jul 1988. Translated from Japan Institute of Light Metals, Journal (Japan), v. 36, 791-798(Dec 1986). (NASA-TT—20294; NAS—1.77:20294). 17p. NTIS, PC A03/MF A01.

The effects of Zr and Cr additions on the microstructure, fracture toughness, tensile properties, and ductility of Al-Zn-Mg alloys are investigated. The data reveal that the grain size decreases and the fracture toughness increases as the Zr content increases; a fracture toughness maximum is detected when the Zr content is 0.18 percent; and for Zr additions greater than 0.18 percent, the distributive density of the eta-prime phase becomes lower when the large dispersoids appear in the matrix and the fracture toughness decreases. For the Cr additions, it is observed that the tensile strength decreases with increasing Cr additions and the fracture toughness increases up to 0.32 percent. It is determined that Zr additions have a significant effect on tensile strength and Cr content affects the absorbed energy.

936 **(N—88-24758) Precipitation processes of Cu-Zr-Cr alloys.** Suzuki, H.; Kanno, M. Translated from *Nippon Kinzoku Gakkaishi ;* **36**: No. 4, 363-368(Jun 1988). 17p. (NASA-TT—20168; NAS—1.77:20168). NTIS, PC A03/MF A01.

Precipitation processes of a Cu-Zr-Cr ternary alloy were investigated by means of specific heat and electric resistance measurements, computing with those of Cu-Zr and Cu-Cr binary alloys. Specimens were solution treated at 950 C and quenched into iced water. Subsequently they were aged or cold rolled about 83 percent and then aged under various conditions. The precipitation processes during aging at temperatures elevated at a constant rate of 2 C min were examined in detail. The results obtained are detailed.

937 **(N—88-24760) Critical cooling rates on solution treatment of Cu-Cr and Cu-Be alloys.** Todi, T. Translated from *Nippon Kinzoku Gakkaishi ;* **21**: 237-242(Jun 1988). 18p. (NASA-TT—20163; NAS—1.77:20163). NTIS, PC A03/MF A01.

It is shown that certain high strength and high electrical conductivity copper alloys, Cu-Cr and Cu-Be, do not undergo sufficent age hardening by slow quenching. This problem has been recently highlighted by the increasing demand for high strength alloys in the form of a large section. In order to find out the effect of the cooling rate on the formation of a supersaturated solid solution for Cu-Cr and Cu-Be alloys, the Jominy end quench tests and the isothermal treatment and aging tests were performed. A 25 diameter times 100 mm test bar similar to the standard bar for steel was used for the Jominy tests and the 1.0 mm diameter wire for the isothermal treatment and aging tests to determine the C-curve. The results obtained are detailed. It seems that the aging characteristics were particularly influenced by the cooling rate in the temperature range near the nose of the lower C-curve. It is concluded that the critical cooling rate on solution treatment of this alloy is 55 to 60 C/sec at about 500 C.

938 **Ultrasonic waves in austenitic steels.** Ogilvy, J.A. (Harwell Lab., Didcot (England)). pp 15-22 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A ray tracing program, RAYTRAIM (RAY TRacing through Anisotropic and Inhomogeneous Materials), has been developed to act as a guide to ultrasonic wave behavior in austenitic welds. Results for the model are presented to indicate its capabilities. Its operating principles are briefly outlined. Compression and shear wave propagation and grain structure results for a downhand MMA V-butt weld under diverging beam conditions and for a submerged arc transition weld under focused beam conditions are graphed. Ray amplitudes and travel times are tabulated.

939 **Numerical modeling of elastic wave propagation in anisotropic materials.** You, Z.; Lord, W.; Ludwig, R. (Colorado State Univ., Fort Collins (USA)). pp 23-30 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Previous papers have reported on a 2-dimensional finite element computer code for modeling ultrasonic wave propagation. The long-range objective of the code is to predict realistic transducer signals in complex 3-dimensional materials under conditions of wave attenuation and material anisotropy and inhomogeneity. In this paper anisotropic effects were added to the code to make it capable of modeling wave propagation in materials such as austenitic welds and centrifugally cast stainless steels. Predictions of wave propagation parallel, perpendicular, and at 45 degrees to the grain axes were made for an orthorhombic material. Model-generated graphs from these three predictions were merged to indicate model performance for depicting the defocusing, focusing, and skewing typical of anomalous wave behavior in anisotropic media.

940 **Model for the propagation of Gaussian beams in anisotropic media.** Thompson, R.B.; Newberry, B.P. (Iowa State Univ., Ames (USA)). pp 31-39 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A Fresnel approximation was developed for the propagation of elastic waves in anisotropic solids and was used to describe the propagation of a Gaussian beam. The Gaussian solution differed from its isotropic medium form by the inclusion of beam skew and divergence effects. Skew was determined by the first derivative of slowness with propagation direction and divergence was determined by the second derivative. The role of this solution and its generalization to the full Gauss-Hermite series in modeling the results of ultrasonic NDE in anisotropic materials such as composites and austenitic steels is assessed.

941 **Ultrasonic beam distortion in transversely isotropic media.** Roberts, R.A.; Kupperman, D.S. (Argonne National Lab., IL (USA)). pp 49-56 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The Fourier transform representation for the three-dimensional problem of transmission of a bounded ultrasonic beam from an isotropic to a transversely isotropic half space was numerically evaluated. Features in the distortion of the transmitted beam profiles were observed. Comparisons were made to previously obtained experimentally observed beam profiles from columnar-grain steels which revealed that the observed distortions are likely the result of conditions of transverse isotropy. Typical beam distortion encountered during transmission into a fiber-reinforced composite was also calculated.

942 **Circumferential wave propagation in thin elastic shells.** Talmant, M.; Quentin, G. (Universite Paris (France)). pp 71-78 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Experimental results are given for the ultrasonic response of a perfect cylindrical duraluminum shell to a short impluse. The group velocity variations of the observed circumferential waves

versus frequency were deduced from the resonances observed in the frequency spectrum. The results were compared with dispersion curves for normal modes of a thin plate immersed in a fluid. Results for the interaction of circumferential waves generated in the shell with an internal groove parallel to the shell axis are also evaluated. Two circumferential waves were observed. One had characteristics similar to leaky Lamb waves; the other corresponded to a Stonely type wave.

943 **Quantitative studies of Lamb waves in thin materials using laser techniques.** Hutchins, D.A.; Lundgren, K. (Queen's Univ., Kingston, Ontario (Canada)). pp 79-83 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The nondestructive evaluation of thin materials using transient Lamb waves was examined. A pulsed laser was used for ultrasonic generation with detection by interferometry. It was shown that by using a wide bandwidth and well-defined source and receiver locations both the thickness and elastic constants of the test materials could be estimated using transient Lamb wave motion. The technique was applied to thin sheets of aluminum and metallic glass by the analysis of frequency dispersion in the a_0/ Lamb mode.

944 **Wave scattering and guided wave considerations in anisotropic media.** Rose, J.L.; Pilarski, A.; Tverdokhlebov, A.; Balasuburamaniam, K.; Dale, J.; Diprimeo, D. (Drexel Univ., Philadelphia, PA (USA)). pp 85-94 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A numerical integration ultrasonic field analysis computation model is outlined and a variety of experimental and analytical techniques are illustrated for characterizing the anisotropic nature and the corresponding grain structure associated with centrifugally cast stainless steel. The feasibility of using simple techniques such as skip distance, critical angle, and surface wave velocity measurements to obtain preliminary material properties is demonstrated. The question of choosing the proper propagation mode from which the direction of the anisotropic vector can be established is addressed. Ultrasonic field and phase velocity profiles are given and skew angles are graphed and compared to experimental and classical techniques.

945 **Effect of crack closure on eddy current signals.** Nakagawa, N.; Kogan, V.G.; Bozzolo, G. (Iowa State Univ., Ames (USA)). pp 173-179 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The crack closure problem was studied quantitatively in two stages. As long as electrical contacts were not created between the crack walls the eddy current signal showed no irregularity when the crack was tightly closed. Once contacts began to develop as a result of closure, however, the behavior of the signal changed dramatically. Unusually large phase shifts of the impedance away from 90 degrees were considered as indicative of contact initiation. Results are graphed for various crack configurations.

946 **Thin, finite-plate, clad thickness determination using eddy currents.** Hulbert, J.K.; Maxfield, B.W. (Innovative Sciences, Inc., San Leandro, CA (USA)). pp 199-206 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An eddy current analysis technique is presented which is based on determining the mutual impedance of two coaxial coils placed adjacent to a clad surface whose thickness and conductivity are not precisely known. In cases where the conductivities of the clad and substrate layers are comparable the detailed behavior of the mutual impedance is fairly subtle. For the properties of conductivity and thickness to be deduced from a measurement of the impedance versus frequency the effect on the impedance produced by changes in these properties must have some degree of orthogonality. The theoretical expectations for behavior indicative of a reasonable degree of orthogonality are examined. Derivatives are established which have sufficiently different behavior as a function of frequency to expect the least squares method to be applicable. Constraints on using the derivatives are outlined.

947 **Measurement and correlation of eddy current field interactions with material and flaw dimension variables.** Christner, B.K.; Long, D.L.; Rummel, W.D. (Martin Marietta Astronautics Group, Denver, CO (USA)). pp 207-214 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method was developed for the inexpensive preparation of eddy current test specimens containing defects of predetermined and precisely known dimensions and orientations that represented defects encountered in actual service conditions. The method uses precisely cut mica chips to simulate flaws of variable dimension by casting the chips in the desired orientation in low melting temperature alloys with conductive properties comparable to commonly used engineering materials. CERROBEND, a bismuth base alloy from Cerro Metal Products, was selected. Pertinent mechanical and electrical properties of the alloy are listed and the sample preparation method described in detail. Eddy current responses as functions of crack length and flaw depth using the mica simulations are evaluated. Mica defect response compared to crack and EDM response is assessed.

948 **Thermal imaging of barrier coatings on refractory substrates.** Murphy, J.C.; Maclachlan, J.W.; Aamodt, L.C. (Johns Hopkins Univ., Laurel, MD (USA)). pp 245-252 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method is described for thermally imaging ceramic and other insulation coatings with low thermal conductivity which does away with the thermal penetration limitations associated with normal thermal procedures for such materials. The method uses a quasi-parallel data acquisition technique in the time domain with an infrared scanner and is shown to be applicable to materials with low thermal diffusivities where the thermal transit times are at least a few hundred milliseconds. Three different systems are studied including a specimen of 7059 glass coated with a thin layer of platinum-chrome black, a ceramic thermal barrier coating on a nickel based superalloy, and a nickel-aluminide oxidation resistant coating on the same superalloy.

949 **Use of imaging techniques for eddy current NDE.** Hedengren, K.H.; McCary, R.O.; Young, J.D. (General Electric Corporate Research and Development, Schenectady, NY (USA)). pp 357-365 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Eddy current techniques were used to locate surface penetrating fatigue cracks on the order of 10 mils long by 5 mils deep for purposes of meeting government requirements for flaw detection in the rotating parts of aircraft engines. To address this goal the use of eddy current NDE was approached from a systems point of view based on image creation. Image processing techniques were used to improve the detection probability of small flaws and to extract quantitative information. Images were also used to evaluate system performance and to characterize performance for eddy current probes. Image results are illustrated and a block diagram of the test facility is provided.

950 **Ultrasonic methods for characterizing the interface in composites.** Simmons, J.A.; Drescher-Krasicka, E.; Wadley, H.N.G.; Rosen, M.; Hsieh, T.M. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 893-901 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Theoretical approaches and experimental techniques are given for characterizing the interface zone in composites using ultrasonic interference waves and for constructing micromechanical models of those interfaces. The theoretical framework was derived from ultrasonic scattering theory with a single dimension of material constant variability (in the direction normal to the interface). The theory is illustrated for layered (planar) and cylindrical (fibrous) geometries. Experimental data were derived for leaky wave mode energy transfer, wave velocity, shear velocity, and mode conversion as functions of microstructure and orientation across interfaces between planar steel 4340 and Ti-6Al-4V alloy and between steel fibers in an aluminum matrix. Computed data are compared to the results.

951 **Characterization of film adhesion by acoustic microscopy.** Mal, A.K.; Weglein, R.D. (Univ. of California, Los Angeles (USA)). pp 903-910 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Procedures and results are given for the reflection acoustic microscopic determination of adhesion between a titanium coating and a beryllium substrate. Relevant features of the acoustic microscope, its instrumentation, and its guided wave generation behavior are described. Rayleigh wave dispersion and phase velocity were measured over a wide frequency range for both bad and good adhesions. Substantial differences were observed in the dispersion and tentatively related to the bond properties. Wave dispersion curves were calculated for the two lowest modes that may propagate in this regime. Data are also given for shear and surface acoustic wave velocities as functions of thickness and density and a mathematical model used to interpret the data is discussed.

952 **Influence of interfacial conditions on the ultrasonic wave interaction with multilayered media.** Nayfeh, A.H.; Taylor, T.W. (Univ. of Cincinnati, OH (USA)). pp 919-926 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Analytical solutions were developed for the interactions of ultrasonic waves with multilayered material plates immersed in liquid and comprised of steel, copper, and epoxy. Interfacial continuity and discontinuity conditions were theoretically and experimentally investigated for rigid and smooth adhesive and diffusion bondings. Propagation modes were solved by using a matrix transfer technique in which the propagation matrix for a layered stack was constructed by extending the solution from one layer to the next while satisfying interfacial continuity conditions. Results are graphed.

953 **Nondestructive evaluation of adhesive bonds using leaky Lamb waves.** Teller, C.M.; Diercks, K.J.; Bar-Cohen, Y.; Shah, N.N. (Texas Research Institute, Austin (USA)). pp 935-942 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results are given on the feasibility of using leaky Lamb waves to detect and delineate bond surface flaws in relatively thick bonded rubber-to-metal structures when the adherends remain in intimate contact. The test specimens were flat stainless steel plates bonded to neoprene 5109S. One specimen class had debonds programmed in the adhesive layer by masking the steel surface during the adhesive application. For the other class a masking pattern was employed during the adhesion process to achieve a specified degree of partial bonding. The leaky Lamb wave method detected and outlined debonds that were not reliably detected by conventional ultrasonic pulse-echo methods. The method also readily differentiated a partially bonded from a fully bonded surface.

954 **Ultrasonic evaluation of the nonlinearity of metals from a design perspective.** Wong, T.E.; Johnson, G.C. (Univ. of California, Berkeley (USA)). pp 1203-1210 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The nonlinearity leading to the acoustoelastic effect indicates that the Young modulus and Poisson ratio are not constants but instead vary with the application of stress. This paper assesses the extent to which these two parameters vary for the test case of aluminum alloy 7039-T64 and compares predicted values for the changes to measurements from uniaxial tension and compression tests. Calculations of the expected changes for a variety of other engineering materials are presented, including germanium, copper, gold, magnesium, molybdenum, niobium, nickel, silicon, silver, steel, and tungsten. Results indicate that the change in the Young modulus during uniaxial loading is 10 times the elastic strain for a wide range of metals.

955 **Application of the grain boundary internal friction peak to the determination of optimum deformation conditions of a superplastic alloy.** Iwasaki, K.; Shichung, Y.; Yiting, W.; Lide, Z. (Institute of Physical and Chemical Research, Wako (Japan)). pp 1247-1253 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The grain boundary internal friction peak of an alloy with the composition in wt% Al-2.7Li-1.2Cu-0.9Mg-0.14Zr was measured with a variable frequency pendulum. The Arrhenius line for the higher temperature edge of the peak was used as a guide for determining the optimum superplastic temperature and strain rate forming conditions for the alloy. Temperature and frequency spectra for the grain boundary peaks are given along with a schematic of the instrumentation.

956 **Search for NDE methods to characterize thermal history and mechanical properties of Al-Li alloys.** Bracci, D.J.; Garikepati, P.; Jiles, D.C.; Buck, O. (Iowa State Univ., Ames (USA)). pp 1255-1262 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results are presented from an investigation into fieldable NDE methods capable of on-line monitoring of heat treatment methods and mechanical properties pertinent to the quality control of Al-Li alloys. Eddy current measurements were determined to be particularly sensitive to Li in solid solutions. Measurements of hardness were sensitive to the volume fractions and probably the morphologies of the precipitates formed. Materials included an Al-2.2wt% Li alloy and Al 2090. Results are given for aging time and temperature, dc resistivity, strain-to-failure curves, yield strength, and a model for diffusion-limited precipitation.

957 **Reflection of ultrasonic waves by an imperfect diffusion bond.** Sotiropoulos, D.A.; Achenbach, J.D. (Northwestern Univ., Evanston, IL (USA)). pp 1293-1300 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An imperfect diffusion bond was modeled as a deterministic nonperiodic distribution of cracks and the reflection and transmission coefficients were calculated for incident plane longitudinal waves. The model calculates the crack-opening volumes for any number of cracks under the action of a normally incident ultrasonic wave. The effect of a neighboring crack is represented by a pair of dipoles at the geometrical center of that crack. The model was verified by comparison with exact results and showed that often only the next nearest cracks have an appreciable influence on the ultrasonic coefficients. The model approximates the reflection and transmission coefficients in terms of the number of cracks per unit length.

958 **Ultrasonic characterization of solid-solid bonds from microstructural changes.** Rose, J.H. (Iowa State Univ., Ames (USA)). pp 1311-1318 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method was developed for evaluating acoustically transparent atom-atom bonding and embrittled bonds. The method is based on the premise that the bonding process may induce microstructural changes in the metal and that these changes in microstructure, characterized by ultrasound, can be directly or indirectly related to bond quality. Methods for determining microstructure using ultrasonic attenuation and velocity measurements are discussed and the technique is then applied to the inspection of diffusion bonded samples of IN-100 in jet engine turbine blade fabrication. Results are graphed and summarized for good and bad samples.

959 **Ultrasonic non-destructive evaluation of solid state welds.** Thomas, G.; Spingarn, J. (Sandia National Labs., Livermore, CA (USA)). pp 1319-1325 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC04-76DP00789.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Considerations in the ultrasonic inspection of diffusion bonds in which a thin contaminant layer impedes full metallurgical bonding are addressed. A microstructural classification scheme is presented in which welds and their failure potentials are characterized not by their mechanical performance but by factors such as grain growth across the interface, ductility, and level of contamination. Ultrasonic C-scans were evaluated on the basis of reflection amplitudes. Algorithms determined by extracting analytical features from the ultrasonic waveforms were used to separate good from poor low temperature diffusion welds in both a martensitic and an austenitic steel. Discrimination features based on the high frequency energy content of the bonds seemed to provide the best predictions of weld quality.

960 **Ultrasonic NDE techniques for integrally fabricated rotors.** Gray, T.A.; Margetan, F.J.; Thompson, R.B. (Iowa State Univ., Ames (USA)). pp 1327-1334 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results are assessed for grazing incidence experiments conducted to demonstrate the ability of the technique to distinguish bonds of different quality. The bonds were produced by systematically degrading fabrication procedures of major engine manufacturers. Results are also given for a quantitative experimental study of the quasi-static spring model for the interaction of ultrasonic waves with an imperfect interface. Model samples with controlled interfacial disbonding were employed to demonstrate the high sensitivity of the grazing incidence configuration and the quantitative relationship of the measurements to the degree of disbonding. Bonded samples of Ti-64 and IN100 were tested. Scan line maximum amplitudes and model and experimental longitudinal wave reflection coefficients are graphed.

961 **Strength and ultrasonic characterization of metallic interfaces.** Palmer, D.D.; Roberts, C.D.; Rehbein, D.K.; Smith, J.F.; Buck, O. (Iowa State Univ., Ames (USA)). pp 1335-1342 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The application of ultrasonic reflectivity for characterizing the quality of a variety of copper diffusion bonds was assessed. Bond quality was also determined by ultimate engineering stress and empirical correlations between reflection coefficients and ultimate tensile stresses were established. Fractography of the failed bonds provided data on the relative fraction of bonded areas. These data were used to test a distributed spring model. Reflection contour maps and micrographs are presented. Ultimate tensile stresses are graphed against reflection coefficients for both theoretical and experimental values.

962 **Measurement of stress in steel structures with SH wave EMATS.** MacLauchlan, D.T.; Burns, L.R.; Alers, G.A. (Magnasonics, Inc., Albuquerque, NM (USA)). pp 1399-1404 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A technique was previously reported which uses surface skimming SH waves propagating on a web of welded railroad rails subjected to compressive and tensile loads in a testing machine to make a quantitative measurement of the sign and magnitude of the stress. This paper describes an extension of that technique toward the development of an instrument and probe to be used to monitor thermal stresses in railroad tracks after installation in the field. Design and performance specifications for the EMAT system are given along with the theoretical and experimental background for the technique.

963 **Nondestructive residual stress measurements in railroad wheels using the low-field magnetoacoustic test method.** Namkung, M.; Utrata, D. (NASA Langley Research Center, Hampton, VA (USA)). pp 1429-1438 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A low-field magnetoacoustic stress measurement technique was developed and a prototype system designed for whole railroad wheel testing. Two wheels were tested with different signs of residual stress states determined by saw cutting techniques. The test and data acquisition system consisted of an electromagnet, acoustic instrumentation, and a control computer. The fractional frequency shift as a function of the current applied to the electromagnets was determined. A time dependence for this shift was discovered for the closed sawcut wheel. A quantitative analysis was conducted based on magnetic aftereffect. Magnetic and microstructural behavior such as magnetostriction, carbon diffusion, and lattice displacement were assessed.

964 **Crystallographic texture in rolled aluminum plates: neutron pole figure measurements.** Reno, R.C.; Fields, R.J.; Clark, A.V. Jr. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 1439-1445 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Neutron pole figures were taken on six samples of aluminum plate with different hot rolling histories. Complete pole figures

were generated by placing the samples in a neutron beam, selecting the appropriate detector orientation to observe diffraction from crystal planes defined by Miller indices, and measuring beam transmission over a range of sample orientations which span the entire hemisphere above the plane of the plate. Experiments were conducted at the NBS reactor and data were converted to pole figures using programs written at NBS. The results of inversion and reconstruction procedures are discussed and results are compared for neutron and ultrasonic measurements of orientation distribution coefficients.

965 **Study of strain-induced phase transformations in TiNi alloy by electric resistance method.** Muang, Y.; Lu, L.; Zou, L.; You, W. (Beijing Univ. of Iron and Steel Technology (China)). pp 1447-1454 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Crystal phase transformations induced by plastic deformation in a Ni-55.3wt% Ti-44.7wt% alloy were studied by measuring electric resistance as a function of deformation at constant temperature. Torsion was used to deform the sample. After every measurement for deformation-dependent resistance the wire sample was heated from freezing to 80°C and tested for the shape memory effect. Graphs are included which demonstrate the resistance as a function of the plastic deformation angle and indicate the onset of martensitic transformations at various temperatures.

966 **Strain dependence of the magnetic properties of AISI 4130 and 4140 alloy steels.** Jiles, D.C.; Utrata, D. (Iowa State Univ., Ames (USA)). pp 1455-1462 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results are presented from the effects of plastic deformation on the magnetic properties of steels 4130 and 4140. Coercivity, hysteresis loss, and initial magnetic susceptibility depended on the deformation level. Maximum differential permeability was insensitive to plastic deformation for most of the elongation range. Since this parameter was dependent on elastic strain, this result, when coupled with the results for coercivity and initial permeability, became a method of distinguishing between plastic and elastic strain. The effects of microstructure and residual strain on the magnetic properties were also assessed. Remanence was weakly dependent on the residual strain while the maximum differential permeability did not vary systematically.

967 **Nondestructive evaluation of temper embrittlement in HY80 steel.** Allison, S.G.; Yost, W.T.; Cantrell, J.H.; Hasson, D.F. (NASA Langley Research Center, Hampton, VA (USA)). pp 1463-1470 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results are presented from preliminary research at NASA Langley Research Center toward determining a nondestructive test method for detecting temper embrittlement in HY80 steel. The technique measures magneto-acoustic emission associated with reversible domain wall motion at low magnetic fields. The objective of the research was to develop field instrumentation for assessing temper embrittlement in large cast HY80 components without their removal from service. A schematic of the data acquisition system is provided. Results indicate that the magnetic and the magneto-acoustic properties of the steel are affected by embrittlement. The implications of this effect for field NDE are discussed.

968 **Objective ultrasonic characterization of welding defects using physically based pattern recognition techniques.** Burch, S.F. (Harwell Lab., Oxfordshire (England)). pp 1495-1502 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An approach to reliable and objective defect characterization based on 3-D defect imaging using multiple angles of ultrasound and followed by the computation of three features was applied in two previous papers to results from 70 buried defects scanned with two pulse echo inspection techniques. In this paper the approach was extended to the characterization of planar defects oriented at angles of 0 and 7 degrees to the vertical using a combined 45 degree pulse echo/tandem inspection technique. The computed feature values for the three defect classes (cracks, inclusions, and porosity) fell into distinct clusters without any overlapping points. Calibration and normalization methods were used to ensure that the three inspection techniques gave compatible feature values.

969 **On-line fatigue crack growth monitoring in externally pressurized vessels using the alternating current potential drop (ACPD) technique.** Livingstone, F.; Kilpatrick, I.M. (Admiralty Research Establishment, Dunfermline (Scotland)). pp 1531-1539 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Advances made in the application of an on-line monitoring system using the ACPD technique are described. Data for a series of fatigue cycle tests on simple vessels with single stiffeners are presented. Modifications made to the system, including redesign of the ACPD contact and incorporation of a watertight gland to enable underwater operation, are discussed and illustrated, and the results of these modifications are evaluated. Data for test vessels are plotted. The system can size cracks to within 0.75 mm, provide data on crack growth rate, identify the effects of interruptions in fatigue cycling, and monitor crack closure and opening during fatigue cycling.

970 **Novel fabrication technique for prescribed interior cracks in a metal.** Hsu, D.K.; Thompson, D.O. (Iowa State Univ., Ames (USA)). pp 1541-1548 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method based on a powder metallurgy technique was developed for fabricating interior cracks in metals. The method involves the cold pressing of iron powder on both sides of a copper foil to produce an iron slug. The slug is sintered and then cold pressed again. Sintering melts the copper foil and the liquid copper is drawn away into the adjacent iron voids by capillary flow. The procedure produced a crack a few micrometers thick and of identical lateral size and shape as the original copper foil. Samples were ultrasonically tested by the pulse echo method. Physical properties of the cracks were determined. Scanning electron microscopy was also used to assess the cracks.

971 **Precision ultrasonic thickness measurements of thin steel disks.** Blessing, G.V.; Eitzen, D.G.; Henning, J.F.; Clark, A.V. Jr.; Schramm, R.E. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 1563-1572 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method for the precise measurement of ultrasonic echo transit times and the subsequent calculation of part dimensions based on a knowledge of the material ultrasound speed is devel-

oped. Flat disks possessing a wide range of grain sizes representative of the variable metallurgy of the steel shells for which the method was intended were tested. Factors affecting ultrasonic dimensional precision including grain size, texture, sample temperature, and surface roughness are discussed with emphasis on precision limitations due to finite grain sizes in thin parts. Both shear and longitudinal wave measurements were made. Comparisons were drawn to precision interferometer measurements.

972 **In-process radiography of arc weld.** Rokhlin, S.I.; Guu, A.C.; Applegate, D.E. (Ohio State Univ., Columbus (USA)). pp 1581-1588 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The use of real time x-ray radiography for the monitoring and control of submerged arc welding and for observation of the weld pool was demonstrated. The image was digitized to permit the extraction of quantitative information on weld reinforcement and weld penetration. This information was used to control the welding current to achieve full weld penetration. A schematic diagram of the instrumentation and exposure room is given along with an x-ray image and schematic illustration of the submerged arc welding process.

973 **Computer aided ultrasonic porosity assessment for cast aluminum alloy.** Rypien, D.V.; Sprague, A.; Adler, L. (Ohio State Univ., Columbus (USA)). pp 1623-1629 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A computer aided porosity assessment program was developed for cast aluminum alloys which combines an ultrasonic attenuation spectroscopy measuring technique and correction algorithms. By measuring the porosity induced attenuation of the cast alloy the program calculates the volume fraction and average pore size of the porosity. Factors which affect the accurate measurement of the induced attenuation are corrected. The program optimizes the measuring process by using a combination of time and spatial averaging.

974 **Flaw detection in railroad wheels using Rayleigh-wave EMATS.** Schramm, R.E.; Clark, A.V. Jr.; Mitrakovic, D.V.; Shull, P.J. (National Bureau of Standards, Boulder, CO (USA)). pp 1661-1668 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Work underway at the NBS in developing an automated on-line EMAT system for on-site railroad wheel inspection and flaw detection is described. The transmitter and receiver transducers are designed for pitch-catch operation and operate on Rayleigh waves. The system includes a function generator, gated power amplifier, line driver, and impedance matching circuits. Beam optics and operating characteristics are discussed. Signal amplitudes as a function of transducer position around the wheel circumference and other results are plotted. Preliminary results indicate that the electronics and transducer design generates a strong Rayleigh wave in a cast iron wheel.

975 **Noncontact temperature measurements of hot steel bodies using an electromagnetic acoustic transducer (EMAT).** Boyd, D.M.; Sperline, P.D. (Pacific Northwest Lab., Richland, WA (USA)). pp 1669-1676 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC06-76RL01830.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A laser/EMAT system was constructed for noncontact measurements of hot carbon and stainless steels. A pulsed EMAT was designed for high-temperature operation using continuous contact up to 750°C and momentary contact up to 1300°C. The 1-Mhz EMAT was able to detect time-of-flight longitudinal signals through ten inches of stainless steel up to 1300°C and carbon steels up to 900°C. The EMAT detected Barkhausen noise in the carbon steels below the Curie temperature. Results for time-of-flight and amplitude measurements versus temperature are plotted.

976 **Electromagnetic augmentation for casting of thin metal sheets.** Hull, J.R. US Patent Application 6-113,707. 28 Oct 1987. 36p. Contract W-31109-ENG-38. NTIS, PC A03/MF A01.

Thin metal sheets are cast by magnetically levitating molten metal deposited in a model within a ferromagnetic yoke and between AC conducting coils and linearly displacing the magnetically levitated liquid metal while it is being cooled by the water-cooled walls of the mold to form a solid metal sheet. A conducting shield is electrically coupled to the molten metal sheet to provide a return path for eddy currents induced in the metal sheet by the current in the AC conducting coils. In another embodiment, a DC conducting coil is coupled to the metal sheet for providing a direct current therein which interacts with the magnetic field to levitate the moving metal sheet. Levitation of the metal sheet in both molten and solid forms reduces its contact pressure with the mold walls while maintaining sufficient engagement therebetween to permit efficient conductive cooling by the mold through which a coolant fluid may be circulated. 8 figs.

977 **Method for controlling gas metal arc welding.** Smartt, H.B.; Einerson, C.J.; Watkins, A.D. US Patent Application 6-083,381. 10 Aug 1987. 26p. Contract AC07-76ID01570. NTIS, PC A03/MF A01.

The heat input and mass input in a Gas Metal Arc welding process are controlled by a method that comprises calculating appropriate values for weld speed, filler wire feed rate and an expected value for the welding current by algorithmic function means, applying such values for weld speed and filler wire feed rate to the welding process, measuring the welding current, comparing the measured current to the calculated current, using said comparison to calculate corrections for the weld speed and filler wire feed rate, and applying corrections. 3 figs., 1 tab.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 590, 591, 592, 593, 595, 597, 893, 897, 912, 913, 948, 1095, 1126, 1147, 1336, 1339, 1349, 1350, 1353, 1366, 1382, 1385, 1406, 1406, 1418, 1435, 2456, 2460, 2463, 2467

978 (ACIESP—60-Vol.1, pp 15) **Finely divided solids.** Jafelicci Junior, M. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

979 (ACIESP—60-Vol.1, pp 16) **Nb-ATR alumina pieces prepared by slip casting method.** Shibuya, N.H. (Fundacao de Tecnologia Industrial, Lorena (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

980 (ACIESP—60-Vol.1, pp 18) **Preparation and characterization of Pb(Mg/sub 1/3/ Nb/sub 2/3/) O/sub 3/ type ceramics with high dielectric performance.** Martel, G.G.; Pozzi Junior, N.; Aegerter, M.A.; Souza, D.M.P.F. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

981 **(AD-A—195615/0/XAB) Processing of mixed-oxide superconductors.** Micheelsen, B.; List, F. (Cambridge Univ. (UK). Dept. of Engineering). Nov 1987. 36p. NTIS, PC A03/MF A01.

The most-important conclusion was that the barriers preventing useful supercurrents are rather widely spaced and this should make it easier to develop a process to eliminate them. It has become clear that two sets of critical-current densities are involved in these materials, the currents between grains and the currents within grains. To distinguish between them, samples must be made in the form of hollow cylinders and the flux measured in coils round the cylinders and within them. This apparatus is now working, and it is being calibrating it. The author shall then be in a position to assess quantitatively the effects of various processing techniques. They are also assembling in inductance apparatus to measure AC losses, which will give further information on the current densities. The magnetic separation is proving a rather complex phenomenon. It is clear that particle size and anisotropy are relevant parameters. The original geometries also led to clumping of the particles which may prevent efficient separation. Work on these problems is in progress on a redesigned apparatus.

982 **(AD-A—195682/0/XAB) Intercalation reactions of monovalent and divalent cations in V_6O_{13} single crystals. Technical report No. 21, 15 July 1985-30 May 1988.** Munshi, M.Z.; Gilmour, A.; Owens, B.B.; Smyrl, W.H. (Minnesota Univ., Minneapolis (USA). Corrosion Research Center). Jun 1988. 2p. NTIS, PC A02/MF A01.

Single Crystal V_6O_{13} positive material is being evaluated in this laboratory for the intercalation of polyvalent cations such as Li, Na Zn, Cu etc. The study involves 1) growth of V_6O_{13} single crystals, 2) the reversible behavior V_6O_{13} towards polyvalent cations, 3) evaluation of the thermodynamic EMF vs composition curves and 4) XRD and SEM determination in order to evaluate any structural changes occurring in the V_6O_{13} as a result of cation intercalation.

983 **(AD-A—196091/3/XAB) Photoinduced self-localized structural distortions in $YBa_2cu_3O_7$-delta: direct evidence of polarons or bipolarons. Technical memo.** Kim, Y.H.; Foster, C.F.; Heeger, A.J.; Cox, S.; Stucky, G. (California Univ., Santa Barbara (USA). Dept. of Chemistry). May 1988. 15p. (TR—5). NTIS, PC A03/MF A01.

Photoinduced infrared absorption measurements of $YBa_2Cu_3O_7$-delta (delta=0.75) in the spectral region from 150/cm to 4000 cm are reported. We observed photoinduced infrared active vibrations (IRAV) modes, associated phonon bleachings, and an electronic transition (from a localized gap state) peaked at 1050/cm (0.13 eV). The spectral features indicate a local tetragonal to orthorhombic distortion in the Cu-O plane around the photoinduced charge carriers in $YBa_2Cu_3O_7$-delta is smaller than La_2CuO_4. The photoinduced structural distortion and the associated self-localized gap state demonstrate that the photoexcitations are relatively long lived polarons or bipolarons.

984 **(CONF-881120—3) Neutron diffraction NDE for advanced composites.** Kupperman, D.S.; Majumdar, S. (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 6p. NTIS, PC A02. Order Number DE88012041/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

The strength and toughness of whisker- and fiber-reinforced composites are controlled to a large extent by the nature of bonding between the fibers/whiskers and the matrix. An important problem in the development of metal matrix and ceramic-ceramic matrix composites is the simultaneous measurement of whisker and matrix residual stress. In certain systems, chemical bonding is supposed to be nonexistent and frictional forces at the interfaces provide the necessary link between the fiber and the matrix. In metal matrix composites, stresses in the fibers can lead to thermal-cyclic fatigue damage. Strain measurements have been acquired nondestructively for alumina/silicon carbide and titanium/silicon carbide composites by means of neutron diffraction techniques at the Argonne National Laboratory Intense Pulsed Neutron Source. Analysis of the experimental results show that the in situ measurement of stress in the laboratory by neutron diffraction techniques is practical. The strain data accumulated could be used to calculate residual stresses in the fibers and the matrix (including stresses at the interface) simultaneously, or determine stresses resulting from external loading. 12 refs., 5 figs., 2 tabs.

985 **(CONF-8806248—1) Microstructural analysis of superconducting ceramics.** Shi, D.; Lee, R.H. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 15p. NTIS, PC A03/MF A01. Order Number DE89000613/JAW.

From Inter/micro-88 conference; Chicago, IL, USA (27 Jun 1988).

Scanning electron and polarized light microscopy were used to analyze the microstructures of high-T/sub c/ superconducting materials in the Y-Ba-Cu-O and Bi-Sr-Ca-Cu-O systems. The superconducting properties of $Y_1Ba_2Cu_3O$/sub 7-x/ samples were found to be strongly affected by the microstructural changes that result from different sintering and heat treatments. Second phases, such as $BaCuO_2$ and CuO_2, were identified by backscattered electron imaging and energy dispersive x-ray analysis. Polarized light microscopy was used to study the twinned structure and phase transformation of the Y-Ba-Cu-O system. The results of microstructural analysis show a consistent correlation between the superconducting and microstructural properties. The process of tetragonal-to-orthorhombic phase transformation was clearly revealed by polarized light microscopy. Crystallization of rapidly solidified $Bi_2Sr_2Ca_2Cu_3O$/sub x/ glass was studied by means of secondary electron imaging. In addition, special techniques were developed for sample preparation. 6 refs., 6 figs.

986 **(ENEA-RT-TIB—88-1) Ceramic materials for fission and fusion nuclear reactors.** Majani, C.; Schippa, B. (ENEA, Casaccia (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1988. 45p. (CONF-8709370—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704434/JAW.

From 12. Teccher meeting; Rimini, Italy (1 Sep 1987).

A general survey on the ceramics for nuclear applications is presented. For the fission nuclear reactor, the ceramics materials are almost totally used as fuel e.g. (U,Pu)O/sub 2/; other types of ceramics, e.g. Uranium-Plutonium carbide and nitride, have been investigated as potential nuclear fuels. The (U,Pu)N compound is to be the fuel for the space nuclear power reactor in the U.S.A. For the fusion nuclear reactor, the ceramics should be the fundamental materials for many components: first wall, breeder, RF heating systems, insulant and shielding parts, etc. In recent years many countries are involved on the research and development of ceramic compounds with the principal purpose of being used in the fusion powerplant (year 2010-2020 ?). An effort has been even made to verify if it is possible to use more ceramic components in the fission nuclear plant (probably differntly disigned) to improve the safety level. 43 refs.

987 **(LBL—25734) High T/sub c/ superconductors: Will they replace helium temperature superconductors for magnets?.** Green, M.A. (Lawrence Berkeley Lab., CA (USA)). Jul 1988. Contract AC03-76SF00098. 5p. (CONF-881120—8). NTIS, PC A02/MF A01. Order Number DE88016634/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

During the last two years, the maximum zero resistance critical temperature for superconductors has risen from 23 K to temperatures above 120 K. This paper presents a sober view of the usefulness of the high T/sub c/ materials for generating magnetic fields in superconducting devices. The high T/sub c/ materials are compared to conventional niobium titanium superconductors in the following areas: critical current density, adiabatic and dynamic stability, normal region propagation velocity, burn out integral, energy per unit volume to quench and the maximum cryogenic stability current density. A look at the whole picture suggests that for most superconducting magnet applications, conventional conductors would be the superconductors of choice for magnets. 19 refs., 3 tabs.

988 (N—88-23872) **Structural ceramics.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1986. 226p. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—). NTIS, PC A11/MF A01.

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

This publication is a compilation of abstracts and slides of papers presented at the NASA Lewis Structural Ceramics Workshop. Collectively, these papers depict the scope of NASA Lewis' structural ceramics program. The technical areas include monolithic SiC and Si_3N_4 development, ceramic matrix composites, tribology, design methodology, nondestructive evaluation (NDE), fracture mechanics, and corrosion.

989 (N—88-23872, pp vp) **Nondestructive evaluation of structural ceramics.** Vary, A. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

Research on nondestructive evaluation (NDE) of structural ceramics for heat engine applications is reviewed. Microfocus radiography and scanning laser acoustic microscopy are the NDE techniques highlighted. The techniques were applied to research samples of sintered silicon nitride and silicon carbide in the form of modulus-of-rupture (MOR) bars. The strength and limitations of the aforementioned techniques are given in terms of probablility of detection for voids in green and sintered MOR bars. Voids for this purpose were introduced by seeding green ceramic bars and characterizing each void in terms of its size, shape, location, and nature before and after sintering. The effects of material density, microstructure, surface finish, thickness, void depth, and size characteristics on detectability are summarized.

990 (N—88-23872, pp vp) **Fracture mechanics.** Shannon, J.L. Jr. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

The application of fracture mechanics to the design of ceramic structures will require the precise measurement of crack growth and fracture resistance of these materials over their entire range of anticipated service temperatures and standardized test methods for making such measurements. The development of a standard test for measuring the plane strain fracture toughness is sought. Stress intensity factor coefficients were determined for three varieties of chevron-notch specimens, and fracture toughness measurements were made on silicon nitrides, silicon carbides, and aluminum oxides to assess the performance of each specimen variety. It was determined that silicon nitride and silicon carbides have flat crack growth resistance curves, but aluminum oxide does not. Additionally, batch-to-batch differences were noticed for the aluminum oxide. Experiments are continuing to explain the rising crack growth resistance and batch-to-batch variations for the aluminum oxide.

991 (N—88-23872, pp vp) **Improved silicon carbide for advanced heat engines.** Whalen, T.J.; Mangels, J.A. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

The development of silicon carbide materials of high strength was initiated and components of complex shape and high reliability were formed. The approach was to adapt a beta-SiC powder and binder system to the injection molding process and to develop procedures and process parameters capable of providing a sintered silicon carbide material with improved properties. The initial effort was to characterize the baseline precursor materials, develop mixing and injection molding procedures for fabricating test bars, and characterize the properties of the sintered materials. Parallel studies of various mixing, dewaxing, and sintering procedures were performed in order to distinguish process routes for improving material properties. A total of 276 modulus-of-rupture (MOR) bars of the baseline material was molded, and 122 bars were fully processed to a sinter density of approximately 95 percent. Fluid mixing techniques were developed which significantly reduced flaw size and improved the strength of the material. Initial MOR tests indicated that strength of the fluid-mixed material exceeds the baseline property by more than 33 percent. the baseline property by more than 33 percent.

992 (N—88-23872, pp vp) **Strength optimization of alpha-SiC by improved processing.** Dutta, S. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

Silicon carbide is of great interest for structural use in aircraft and automobile engines. This ceramic combines high thermal conductivity and low coefficient of thermal expansion, and consequently has good thermal shock resistance. However, like other ceramics, silicon carbide shows strength variability due to processing flaws such as large voids, shrinkage cracks, and inclusions. Agglomerates in the starting powder seem to be the predominant cause of such defects. Improved processing techniques such as slurry pressing and hot isostatic pressing (HIP) were employed to minimize these defects and to improve strength and reliability in the fabricated material. For this purpose 2-inch diameter disks were fabricated by various consolidation techniques. These include: dry pressing and sintering, slurry pressing and sintering, and slurry pressing and HIPing. The results are discussed.

993 (N—88-23872, pp vp) **Improved silicon nitride for advanced heat engines.** Yeh, H.C.; Wimmer, J.M. (Garrett Turbine Engine Co., Phoenix, AZ (USA)). May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

Silicon nitride is a high temperature material currently under consideration for heat engine and other applications. The objective is to improve the net shape fabrication technology of Si_3N_4 by injection molding. This is to be accomplished by optimizing the process through a series of statistically designed matrix experiments. To provide input to the matrix experiments, a wide range of alternate materials and processing parameters was investigated throughout the whole program. The improvement in the processing is to be demonstrated by a 20 percent increase in strength and a 100 percent increase in the Weibull modulus over that of the baseline material. A full characterization of the baseline process was completed. Material properties were found to be highly dependent on each step of the process. Several important parameters identified thus far are the starting raw materials, sinter/hot isostatic pressing cycle, powder bed, mixing methods, and sintering aid levels.

994 (N—88-23872, pp vp) **Improved processing of Si_3N_4.** Sanders, W.A.; Baaklini, G.Y. (Cleveland State Univ., OH (USA)). May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

A sintered Si_3N_4-SiO_2-Y_2O_3 composition, NASA 6Y, was developed that reached four-point flexural average strength/standard deviation values of 857/36, 544/33, and 462/59 MPa at room temperature, 1200, and 1370 C, respectively. These strengths represented improvements of 56, 38, and 21 percent over baseline properties at the three test temperatures. At room temperature the standard deviation was reduced by more than a factor of three. These accomplishments were realized by the iterative utilization of conventional X-radiography to characterize structural (density) uniformity as affected by systematic changes in powder processing and sintering parameters. Accompanying the improvement in mechanical properties was a change in the type of flaw causing failure from a pore to a large columnar beta-Si_3N_4 grain typically 40 to 80 microns, 10 to 30 microns wide, and with an aspect ratio of 5:1.

995 (N—88-23872, pp vp) **Colloidal characterization of silicon nitride and silicon carbide.** Feke, D.L. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

The colloidal behavior of aqueous ceramic slips strongly affects the forming and sintering behavior and the ultimate mechanical strength of the final ceramic product. The colloidal behavior of these materials, which is dominated by electrical interactions between the particles, is complex due to the strong interaction of the solids with the processing fluids. A surface titration methodology, modified to account for this interaction, was developed and used to provide fundamental insights into the interfacial chemistry of these systems. Various powder pretreatment strategies were explored to differentiate between true surface chemistry and artifacts due to exposure history. The colloidal behavior of both silicon nitride and carbide is dominated by silanol groups on the powder surfaces. However, the colloid chemistry of silicon nitride is apparently influenced by an additional amine group. With the proper powder treatments, silicon nitride and carbide powder can be made to appear colloidally equivalent. The impact of these results on processing control will be discussed.

996 (N—88-23872, pp vp) **Molten salt corrosion of SiC and Si_3N_4.** Jacobson, N.S.; Smialek, J.L.; Fox, D.S. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

The most severe type of corrosion encountered in heat engines is corrosion by molten sodium sulfate, formed by the reaction of ingested sodium chloride and sulfur impurities in the fuel. This problem was studied extensively for superalloys, but only recently examined for ceramics. This problem is addressed with laboratory studies to understand the fundamental reaction mechanisms and with burner studies to provide a more realistic simulation of the conditions encountered in a heat engine. In addition the effect of corrosion on the strengths of these materials was assessed. Each of these aspects will be reviewed and some ideas toward possible solutions will be discussed.

997 (N—88-23872, pp vp) **Thermal cyclic durability testing of ceramic materials for turbine engines.** Lindberg, L.J. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

The thermal cyclic durability of commercial ceramic materials for turbine engines was under evaluation since 1978. Ceramic materials are exposed to cyclic diesel-fired burner exhaust at either 1204 or 1371 C (2200 or 2500 F) for up to 3500 hours. The test conditions are selected to simulate the environment experienced by the hot flow path components in an automotive gas turbine engine. The silicon nitride and silicon carbide materials tested are the same ceramic materials currently used on the AGT100 and AGT101 ceramic turbine engine program.

998 (N—88-23872, pp vp) **Fractographic and microstructural evaluation of 3500-hour durability specimens.** Miller, A.D. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

Long term durability testing of candidate ceramic materials for advanced gas turbine applications was performed. Specimens of the materials were exposed to combustion atmospheres under temperature cyclic conditions for times up to 3500 hours and at peak temperatures of 1200 and 1370 C. The specimen strengths after exposure were measured at room temperature and at 1200 C. In addition, a number of physical measurements were taken; however, no microstructural examination of the specimens was performed. Materials examined include: sintered alpha silicon carbide, sintered silicon nitride, and reaction bonded silicon nitride. Sample preparation techniques were developed to provide high quality thin-section specimens which can be examined by transmitted light or thinned using an ion mill for subsequent transmission electron microscopic examination. Specimen preparation techniques and the results of optical and electron microscopic examination of the reaction interfaces of the selected specimens are presented.

999 (N—88-23872, pp vp) **Ceramic matrix composites.** Dicarlo, J.A. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

An overview is presented covering NASA Lewis research efforts aimed at materials and processing development for structurally reliable fiber-reinforced ceramic matrix composites (FRC). With the primary goal of developing technology for strong, tough Si-based FRC with use-temperatures above 1400 C, guidelines for optimum material properties and current problems in achieving these properties are discussed. Brief descriptions of particular research projects directed toward solving these problems are presented. Particular emphasis is placed on those efforts addressing the critical need of developing high performance SiC fibers with stability above 1400 C and with proper coatings for optimum composite structural performance. Based on current results for fiber and matrix development, concluding remarks are made concerning future directions of FRC studies.

1000 (N—88-23872, pp vp) **Polymer precursors for SiC ceramic materials.** Litt, M.H. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

Work on precursor polymers to SiC was performed, concentrating on polymers made from decamethyl cyclohexasilyene units. The initial approach was to synthesize mixed diphenyl decamethyl cyclohexasilane, dephenylate, and polymerize. This produced polymers which had yields of up to 50 percent SiC. (Theoretical yield is 75 percent). The present approach is to make the polymer through the intermediate trans-1,4-diphenyl decamethyl cyclohexasilane. This should produce a crystalline polymer and high strength fibers. These will be thermally decomposed to SiC fibers. This requires new chemistry which is currently being studied.

1001 (N—88-23872, pp vp) **SiC fiber analysis.** Jaskowiak, M.H. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

Polymer derived Nicalon SiC fibers are known to be thermally unstable at temperatures beyond 1200 C. In an effort to further understand the mechanisms of fiber degradation, Nicalon fibers were heat treated at temperatures up to 2200 C and argon gas pressures varying from 0 to 1360 atm. The effects of gas pressure on the thermal stability of the fibers were determined through property comparisons between the pressure-treated fibers and vacuum-treated fibers. Investigation of the thermal stability included studies of the fiber microstructure and mechanical and physical properties before and after treatments.

1002 (N—88-23872, pp vp) **SiC fiber reinforced reaction-bonded Si_3N_4 composites.** Bhatt, R.T. May 1986. NTIS, PC A11/MF A01. (NASA-CP—2427; E—3063; NAS—1.55:2427; CONF-8605352—).

From Structural ceramics; Cleveland, OH, USA (20 May 1986).

A technique for fabricating strong and tough SiC fiber reinforced reaction bonded Si_3N_4 matrix composites (SiC/RBSN) was developed. Using this technique, composites containing approximately 23, 30, and 40 volume fractions of aligned 140 micron diameter, chemically vapor deposited SiC fibers were fabricated. The room temperature physical and mechanical properties were evaluated. The results for composite tensile strength, bend strength, and fracture strain indicate that the composite displays excellent properties when compared with the unreinforced matrix of comparable porosity. The composite stress at which the matrix first cracks and the ultimate composite fracture strength increase with increasing volume fraction of fibers, and the composite fails gracefully. The mechanical property data of this ceramic composite are compared with similar data for unreinforced commercially available Si_3N_4 materials and for SEP SiC/SiC composites.

1003 **(N—88-23985) High frequency ultrasonic characterization of sintered SiC.** Baaklini, G.Y.; Generazio, E.R.; Kiser, J.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 19p. (NASA-TM—100825; E—4013; NAS—1.15:100825; CONF-870172—). NTIS, PC A03/MF A01.

From 11. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (18 Jan 1987).

High frequency (60 to 160 MHz) ultrasonic nondestructive evaluation was used to characterize variations in density and microstructural constituents of sintered SiC bars. Ultrasonic characterization methods included longitudinal velocity, reflection coefficient, and precise attenuation measurements. The SiC bars were tailored to provide bulk densities ranging from 90 to 98 percent of theoretical, average grain sizes ranging from 3.0 to 12.0 microns, and average pore sizes ranging from 1.5 to 4.0 microns. Velocity correlated with specimen bulk density irrespective of specimen average grain size, average pore size, and average pore orientation. Attenuation coefficient was found to be sensitive to both density and average pore size variations, but was not affected by large differences in average grain size.

1004 (N—88-24242, pp 22) **Muon motion in titanium hydride.** Kempton, J.R.; Petzinger, K.G.; Kossler, W.J.; Schone, H.E.; Hitti, B.S.; Stronach, C.E.; Adu, N.; Lankford, W.F.; Reilly, J.J.; Seymour, E.F.W. (Warwick Univ. Coventry (England)). Feb 1988. NTIS, PC A05/MF A01. (NASA-CR—182891; NAS—1.26:182891).

In Materials science with muon spin rotation. Annual report, 1 March 1987-29 February 1988.

Motional narrowing of the transverse-field muon spin rotation signal was observed in gamma-TiH(x) for x = 1.83, 1.97, and 1.99. An analysis of the data for TiH1.99 near room temperature indicates that the mechanism responsible for the motion of the muon out of the octahedral site is thermally activated diffusion with an attempt frequency comparable to the optical vibrations of the lattice. Monte Carlo calculations to simulate the effect of muon and proton motion upon the muon field-correlation time were used to interpret the motional narrowing in TiH1.97 near 500 K. The interpretation is dependent upon whether the Bloembergen, Purcell, and Pound (BPP) theory or an independent spin-pair relaxation model is used to obtain the vacancy jump rate from proton NMR T1 measurements. Use of BPP theory shows that the field-correction time can be obtained if the rate of motion of the muon with respect to the rate of the motion for the protons is decreased. An independent spin-pair relaxation model indicates that the field-correlation time can be obtained if the rate of motion for the nearest-neighbor protons is decreased.

1005 **(N—88-24690) Thrust chamber thermal barrier coating techniques.** Quentmeyer, R.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 19p. (NASA-TM—100933; E—4204; NAS—1.15:100933; CONF-8810192—). NTIS, PC A03/MF A01.

From 72. specialists' meeting of the Propulsion and Energetics Panel; Bath, UK (3 Oct 1988).

Methods for applying thermal barrier coatings to the hot-gas side wall of rocket thrust chambers in order to significantly reduce the heat transfer in high heat flux regions was the focus of technology efforts for many years. This paper describes a successful technique developed by the Lewis Research Center that starts with the coating of a mandrel and then builds the thrust chamber around it by electroforming appropriate materials. This results in a smooth coating with exceptional adherence, demonstrated in hot fire rig tests. The low cycle fatigue life of chambers with coatings applied in this manner was increased dramatically compared to uncoated chambers.

1006 **(NUKEM-FuE—87015) Development of methods for manufacturing ceramic components. Period covered: 1.1.1986 - 30.7.1987. Final report.** Kwasny, R.J.; Hrovat, M. (Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Nov 1987. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755191/JAW.

Based on the know-how of the production of graphite spherical fuel elements, the semihydrostatic pressing is considered as a most promising method for getting ceramic components with good reproducibility of high level material properties. The project was devided in 3 sections: laboratory processing, pilot processing and fabrication of best components. The materials SiC and ZrO/sub 2/ were investigated. In the first section the composition and the processing steps were optimized by manufacturing small, die-pressed shapes (diameter of the pressed shapes {le} 33 mm). The production of large shapes (balls, zylindrical shapes diameter of the pressed shapes 50-85 mm) under optimized processing conditions led to the 2nd section. The densities after sintering of SiC and ZrO/sub 2/ were higher than 98% of theoretic density. To proof, that the use of the semihydrostatic pressing technique enables the production of components with narrow tolerances without machining after sintering, a small number of test components was fabricated. It was shown that the manufacturing of ZrO/sub 2/ valve guides are realistic, although the tolerance of the inner-diameter is very narrow (diameter = 9 mm, tolerance range = 15 {mu}m). (orig.) With 6 refs., 3 tabs., 45 figs.

1007 **(ORNL/Sub—85-22011/1) Dispersoid-toughened silicon nitride composites: Final report.** Buljan, S.T.; Baldoni, J.G.; Neil, J.; Zilberstein, G. (Oak Ridge National Lab., TN (USA); GTE Labs., Inc., Waltham, MA (USA)). Sep 1988. Contract AC05-84OR21400. 87p. NTIS, PC A05/MF A01. Order Number DE89001952/JAW.

This report is a summary of results of a study aimed at the development of silicon nitride composites of enhanced fracture toughness and strength utilizing particulate and whisker dispersoids. Composited with 40% higher fracture toughness and 25% higher room-temperature fracture strength over that of the base silicon nitride "monolith" have been prepared using 30 v/o SiC whisker dispersoids. An increase in fracture toughness of 70% has been observed at 35 v/o whisker additions. Both fracture toughness and strength improvements persist over a wide range of temperatures (25-1200{degree}C). These composites exhibit excellent oxidation resistance and improved resistance to slow crack growth and creep at elevated temperatures. A process for fabrication of complex composite ceramic parts was developed and demonstrated. The present study has also provided extensive information regarding microstructure-property dependence in dispersoid-modified ceramics, which has been utilized to derive a formal theory of fracture toughness and microstructure relationship. 22 refs., 49 figs., 21 tabs.

1008 **(ORNL/Sub—85-22031/1) Processing of sinterable transformation toughened ceramics for application in ceramic technology for advanced heat engines project: Final report.** Rossi, G.A.; Blum, J.B.; Knapp, C.E.; Manwiller, K.E. (Oak Ridge National Lab., TN (USA); Norton Co., Northboro, MA (USA)). Sep 1988. Contract AC05-84OR21400. 75p. NTIS, PC A05/MF A01. Order Number DE89001313/JAW.

Three main types of zirconia toughened ceramics (ZTC) were investigated as potential candidates for heat engine applications, i.e. Mg-PSZ (MgO-Partially Stabilized Zirconia), Y-TZP (Y_2O_3-Tetragonal Zirconia Polycrystals), and ZTA (Zirconia Toughened Alumina). The powders were prepared either via chemical routes or by melting, rapid solidification, and wet milling. Hot isostatic pressing was used in the exploratory part of this program in order to quickly evaluate the potential of each composition without the necessity of optimizing the powder processing composition (Y-TZP) considerable effort was devoted to minimize foreign contaminants and processing flaws in order to improve the properties and the reliability of the ceramics. The Mg-PSZ ceramics could not be fabricated due to persistent cracking solidified (R/S) powders have met all objectives, except the strength and toughness at 1000{degree}C. We believe that the strength goal of 500 MPa at 1000{degree}C for pressureless sintered Y-TZP ceramics is attainable through improvements in processing, but the K/sub IC/ goal of 6 MPa. m/sup {1/2}/ at 1000{degree}C is unrealistic, in view of the lack of transformation toughening at high temperature. The ZTA ceramics have exhibited much better strength and toughness retention at high temperature, vis a vis the Y-TZP materials. These ceramics seem to possess the highest potential for meeting the program goals, but much more processing efforts are needed to opti-

mize their microstructure and maximize their properties. Other advantages of the ZTA materials vs. the Y-TZPs are their lower cost and potentially better resistance to low temperature degradation in the 200--300{degree}C range. 29 refs., 36 figs., 21 tabs.

1009 **(ORNL/Sub—86-95906/1) Developed of toughened Si_3N_4 composites by glass encapsulated hot isostatic pressure: Final report.** Corbin, N.D.; Willkins, C.A. (Oak Ridge National Lab., TN (USA); Norton Co., Northboro, MA (USA)). Aug 1988. Contract AC05-84OR21400. 60p. NTIS, PC A04/MF A01. Order Number DE89001315/JAW.

This one-year program was to develop fully dense Si_3N_4 matrix SiC whisker composites with enhanced properties over monolithic Si_3N_4 materials. Composites were prepared by a Reaction Bonded Silicon Nitride (RBSN) approach followed by Hot Isostatic Pressing (HIPing). The emphasis of this study was to determine the role of whisker aspect ratio, coatings on whiskers, nitridation environments and HIP parameters on composite properties. The ASEA HIP process which has the potential for producing near-net shaped complex geometries was used throughout this program. 26 refs., 22 figs., 7 tabs.

1010 **(PB—88-235601/XAB) Fundamentals of tungsten carbide synthesis (revised). Final report.** Alexander, G.B.; Weeks, J.K.; Bowers-Irons, G. (Technical Research Associates, Inc., Salt Lake City, UT (USA)). 19 Sep 1985. 56p. NTIS, PC A04/MF A01.

This project determined the feasibility of synthesizing tungsten carbide from ammonium paratungstate (APT) by a single-step gaseous reduction and carburization process. Samples were studied for their kinetic behavior in hydrogen-methane mixtures by thermogravimetric analysis. Samples were analyzed by scanning electron microscopy and by x-ray diffraction analysis. Findings of the study are that cobalt, blended in the APT, as well as water-vapor content of the gas stream during reduction to tungsten metal have a dramatic effect upon tungsten particle size and morphology. Tungsten particles over a size range of .3 to 3 microns can be prepared by varying cobalt and water vapor levels during tungsten oxide reduction.

1011 **(PB—88-868195/XAB) Ceramic engine components. January 1970-September 1988 (Citations from the US Patent data base). Report for January 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 129p. NTIS PC N01/MF N01.

Supersedes PB—87-867388.

This bibliography contains citations of selected patents concerning ceramic materials that are resistant to heat, wear, and corrosion processes, and their utilization in internal combustion engines. Fabrication techniques of ignition system components, combustion chamber parts, exhaust valves, turbine rotors, stators, and blades, and heat exchangers are discussed. Ceramic metal composites suitable for engine components are also considered. (This updated bibliography contains 259 citations, 30 of which are new entries to the previous edition.)

1012 **(PB—88-868674/XAB) Sialon ceramics. January 1975-September 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 130p. NTIS PC N01/MF N01.

Supersedes PB—87-867446.

This bibliography contains citations concerning the properties, preparation, fabrication, testing, and applications of SIALON (SI--AL--O--N, the constituents) ceramics. Applications include utilization in gas-turbine components, cutting tools, heat exchangers, and other high-temperature/high-stress components. Sintering methods and materials, and microstructural analyses are discussed. Japanese research and development is included. (This updated bibliography contains 259 citations, 37 of which are new entries to the previous edition.)

1013 **(PNL-SA—15778) Sputter deposition of superconducting YB_2Cu_3O/sub 7-x/ thin films.** Prater, J.T.; McClanahan, E.D.; Weber, W.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 8p. (CONF-880690—4). NTIS, PC A02. Order Number DE89001707/JAW.

From SAMPE electronic materials and processes conference; Seattle, WA, USA (14 Jun 1988).

Homogeneous films of superconducting YBa_2Cu_3O/sub 7-x/ have been sputter deposited using a spherical, mixed-oxide target of YBa_2Cu_3O/sub 7-x/. Films with Y, Ba, and Cu contents within 1% of the starting target material were deposited over an area in excess of 200 cm^2. Four-point resistivity versus temperature measurements on heat treated samples revealed that films taken from different locations within the sputtering chamber had identical transition behaviors to the superconducting state. Although the superconducting properties of the films have not been optimized, these findings do suggest the feasibility of sputtering homogeneous thin films of superconductive YBa_2Cu_3O/sub 7-x/ over large surface areas using spherical targets. 9 refs., 2 figs., 2 tabs.

1014 **(UCRL—99548) Subsurface damage in optical materials: Origin, measurement and removal: Summary.** Hed, P.P.; Edwards, D.F.; Davis, J.B. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 9p. (CONF-881187—1). NTIS, PC A02/MF A01. Order Number DE89001221/JAW.

From Optical fabrication and testing workshop; Santa Clara, CA, USA (2 Nov 1988).

The detection, measurement and removal of subsurface damage is a major effort of the LLNL Optical Sciences and Engineering Group. We will describe and show examples of three methods we are currently using to detect and measure the depth of damage in glasses and crystalline materials: taper polishing and etching, constancy of chemical etch rate, and small specimen fracture. In addition, results will be given to show that the depth of damage can often be approximated from the surface roughness and Young's modulus. 11 refs., 3 figs.

1015 **New modulated structure in a Pb-doped Bi-Ca-Sr-Cu-O superconductor.** Ramesh, R.; van Tendeloo, G.; Thomas, G.; Green, S.M.; Luo, H.L. (Department of Materials Science and Mineral Engineering and National Center for Electron Microscopy, Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **53**: No. 22, 2220-2222(28 Nov 1988).

A new modulated structure has been observed in a Pb-doped Bi-Ca-Sr-Cu-O superconductor (T/sub c//sub ,/o = 105 K) in addition to the incommensurate modulated structure reported by several researchers. This new modulation occurs in the b* direction and shows up as satellite spots to each of the original diffracted spots. Upon cooling to 88 K the diffraction spots due to the original modulation disappear, while the spots due to the new modulation remain. In the case of the undoped samples, the modulation does not disappear upon cooling to 30 K, which is below the T/sub c//sub ,/o of the sample (~75 K).

1016 **Single-target magnetron sputter deposition of high-T/sub c/ superconducting Bi-Sr-Ca-Cu-O thin films.** Dhere, N.G.; Goral, J.P.; Mason, A.R.; Dhere, R.G.; Ono, R.H. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, Colorado 80401). *Journal of Applied Physics;* **64**: No. 10, 5259-5261(15 Nov 1988).

Single-target RF magnetron sputtering was used to deposit superconducting thin films of Bi-Sr-Ca-Cu-O with a T/sub c/o above 80 K. Varying P/sub =/ modified the concentrations of Bi, Cu, and O in the films by 10%—20%. Higher annealing temperatures, especially with brief melting, favored the formation of the higher T/sub c/ phases. Tetragonal phases (6- and 75-K T/sub c/), with a = 3.8097 A, c = 24.607 A, and $Bi_2 Sr_2 CuO_6$ composition, and a = 3.812 A, c = 30.66 A, and Bi_2 Sr/sub 2-//sub x/ Ca/sub 1+//sub x/ $Cu_2 O_8$ composition, were identified. 70—84 K films contained large proportions of a new tetragonal phase, with a = 3.81 A and c = 55.23 A.

1017 **Nonlinear dynamics of spin waves (invited).** Jeffries, C.D.; Bryant, P.H.; Nakamura, K. (Physics Department, University of California, Berkeley, California 94720 and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Applied Physics;* **64**: No. 10, 5382-5385(15 Nov 1988).

For a yttrium-iron-garnet sphere at room temperature, an experimental study is made of the first-order Suhl spin-wave instability using perpendicular pumping at 9.2 GHz with the dc field parallel to the [111] crystal axis. The dynamical behavior of the magnetization is observed with high resolution by varying two control parameters, dc field ($580<H_0<2100$ G) and microwave pump power ($1<P$/sub in/ <200 mW). Within this parameter space quite varied behavior is found: (i) onset of the Suhl instability by excitation of a single spin-wave mode with very narrow linewidth (<0.5 G); (ii) when two or more modes are excited, interactions lead to collective oscillations ("auto-oscillations") with a systematic dependence of frequency (10^4—10^6 Hz) on pump power, these oscillations displaying period-doubling to chaos; (iii) quasiperiodicity, locking, and chaos occur when three or more modes are excited; (iv) abrupt transition to wide band power spectra (i.e., turbulence), with hysteresis; (v) irregular relaxation oscillations and aperiodic spiking behavior. A theoretical model of coupled modes is numerically evaluated and found to exhibit a behavior pattern similar to those observed experimentally.

1018 **Calculation of crystal field parameters in $Nd_2Fe_{14}B$ using realistic energy-band results.** Zhong, X.; Ching, W.Y. (Department of Physics, University of Missouri-Kansas City, Kansas City, Missouri 64110). *Journal of Applied Physics;* **64**: No. 10, 5574-5576(15 Nov 1988).

There have been several attempts to estimate the crystal field parameters of the rare-earth-iron-boron permanent magnets because of its pivotal role in understanding the energy anisotropy, spin reorientation, etc. Usually, a simple point charge model (PCM) was employed which depends on some arbitrary parameters such as the values of ionic charge and screening factors. The crystal field parameters obtained from the PCM generally have correct signs but are too large in magnitude. We report a more accurate preliminary calculation of the crystal field parameters in $Nd_2Fe_{14}B$ based on the results of realistic energy-band calculation. Three levels of calculations are carried out: (1) The PCM calculation which essentially reproduces the published values of other workers; (2) use of effective charges on each ion from the band calculation instead of fully ionic values, which reduces the magnitude of parameters but have signs of some parameters reversed; (3) use of charge distribution calculated from the Bloch wave functions of Nd$_2$ Fe/sub 14/ B gives crystal field parameters in much better agreement with experiment. The results of these calculations and its implication are discussed.

1019 **Electronic structure and surface reactivity of $Nd_2Fe_{14}B$ and related compounds.** Jaswal, S.S.; Langell, M.A.; Ren, Y.G.; Engelhardt, M.A.; Sellmyer, D.J. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska 68588-0111). *Journal of Applied Physics;* **64**: No. 10, 5577-5579(15 Nov 1988).

Studies of electronic and magnetic structure and surface reactivity are reported for $R_3T_{14}B$ compounds where R = Y, Nd, Gd, and T = Fe, Co. The calculations employed the self-consistent, spin-polarized linear-muffin-tin orbital method. Experiments included ultraviolet, x-ray, and Auger electron spectroscopy. Comparisons are made between the calculated and measured electronic densities of states, and the reactions of the surfaces with O_2, H_2, and CO gases are studied. The effects of heat treatment on surface segregation are also reported.

1020 **Magnetic and structural properties of $Nd_2Fe_{14}B$ permanent-magnet films and multilayers with Fe and Ag.** Aylesworth, K.D.; Zhao, Z.R.; Sellmyer, D.J.; Hadjipanayis, G.C. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska 68588-0111). *Journal of Applied Physics;* **64**: No. 10, 5742-5744(15 Nov 1988).

The effects of sputtering conditions on the structure and magnetic properties of Nd$_2$(Fe/sub 0.9/Co/sub 0.1/)$_{14}$B films and multilayers are reported. The samples were sputtered onto temperature-controlled mica and Ta substrates, at temperatures between 20 and 620 °C. X-ray diffraction results indicate that films deposited directly onto 500—600 °C substrates with Fe buffer layers are nearly single-phase materials with the c axis of the grains largely perpendicular to the film plane. Room-temperature magnetization measurements to 17.4 kOe indicate that these films have strong perpendicular anisotropy with coercivities in excess of 10 kOe and magnetizations greater than 100 emu/g. Results for Nd$_2$ (Fe/sub 0.9/ Co/sub 0.1/)/sub 14/ B/Fe multilayers show that films can be produced with either in-plane or perpendicular anisotropy depending on the layer thicknesses. The Fe multilayers were found to have coercivities similar to those for the single layer films. Multilayers made with Ag were found to have significant interdiffusion and secondary phases.

1021 **Local moments, diamagnetism, and time-dependent magnetic response of high-temperature superconductors.** Foeldeaki, M.; McHenry, M.E.; Kalonji, G.; O'Handley, R.C. (Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Applied Physics;* **64**: No. 10, 5812-5814(15 Nov 1988).

The magnetic properties of high-T/sub c/ superconductors RBa$_2$ Cu$_3$O/sub 7-//sub δ/ with R = Y, Gd were investigated in the temperature range 4.2—300 K. To first order, no interaction was found between superconductivity and paramagnetism in the zero-field-cooled state of the Gd-doped samples: after correction for the Curie—Weiss magnetization, the diamagnetism of these samples is very close to that of the Y-doped samples. This suggests that the superconducting screening of an applied field has little effect on the field seen by the R species. The diamagnetic screening is found to be strongly time dependent due to flux penetration, whereas the magnetic ions see the applied field without delay.

1022 **Magnetic behavior of Ho$_1$Ba$_2$(Cu/sub 1-//sub x/ Fe/sub x/)$_3$O/sub 7-//sub y/.** Violet, C.E.; Hahn, P.A.; Datta, T.; Almasan, C.; Estrada, J. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **64**: No. 10, 5911-5912(15 Nov 1988).

We have carried out dc magnetization (x = 0 and 0.05) and ^{57}Fe Moessbauer spectroscopy (x = 0.05) measurements of Ho$_1$Ba$_2$(Cu/sub 1-//sub x/ Fe/sub x/)$_3$O/sub 7-//sub y/ , between room temperature (RT) and 4.2 K. Based on x-ray diffraction results all samples are single phase, and either orthorhombic (x = 0) or tegragonal (x = 0.05). Magnetization measurements determined the onset T/sub c/ to be either 90 K (orthorhombic) or 48 K (tetragonal). Moessbauer spectra between RT and 20 K are nearly identical, each consisting of three superposed quadrupole doublets. As the temperature is lowered below about 10 K the Moessbauer spectra exhibit paramagnetic relaxation. The relaxation time increases by about two orders of magnitude as the temperature decreases from 10 to 4.2 K. No magnetic ordering of the Fe moments was observed.

1023 **Antiferromagnetism in YBa$_2$Cu$_3$O/sub 6+//sub x/ (invited).** Tranquada, J.M. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **64**: No. 10, 6071-6074(15 Nov 1988).

A number of models for high-temperature superconductivity in the layered cuprate perovskites require strong antiferromagnetic superexchange interactions between Cu atoms. The existence of such interactions in La$_2$CuO/sub 4-//sub y/ has previously been demonstrated. In this paper a review is given of recent neutron scattering work performed at Brookhaven studying antiferromagnetism in RBaCu$_3$O/sub 6+//sub x/ with R = Y, Nd. Measurements on ceramic samples with a range of oxygen concentrations have shown that three-dimensional antiferromagnetic ordering of the Cu spins occurs throughout the nonsuperconducting tetragonal phase, corresponding to $0 \leqq x$approx. <0.4. Near $x \sim 0$ the Cu^{2+} atoms in the CuO_2 layers form a simple Neel lattice, and there is no ordering of the nonmagnetic Cu^{1+} atoms in the "chain" sites. With increasing oxygen content some of the Cu^{1+} atoms are converted to Cu^{2+}, which leads to frustration of the interplanar coupling and eventually to a second type of ordering. Very recently, large single crystals of YBa$_2$Cu$_3$O/sub 6+//sub x/ have been grown, making possible

inelastic scattering studies of magnetic excitations. Spin waves within the CuO_2 planes are observed to have a velocity approx. >0.5 eV A.

1024 **Muon spin relaxation studies on high-T/sub C/ superconductors and related antiferromagnets (invited).** Uemura, Y.J. (Department of Physics, Columbia University, New York, New York 10027 and Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **64**: No. 10, 6087-6091(15 Nov 1988).

Muon spin rotation and relaxation (μSR) techniques have been applied to high-T/sub C/ and related systems. In the antiferromagnets La_2CuO/sub 4-//sub y/ and YBa_2Cu_3O/sub 6.0//sub —//sub 6.4/, the muon precession frequency in zero field indicates that the microscopic static ordered moments do not change much despite drastic decrease of the Neel temperature with increasing oxygen content. In the family systems of the new three-dimensional superconductor (BaK)BiO_3, no signature of static magnetic order was found by μSR, in sharp contrast to the two-dimensional systems with CuO planes. In the superconducting specimens La/sub 1.85/Sr/sub 0.15/CuO_4 and YBa_2Cu_3O/sub 6.5//sub —//sub 7.0/, the magnetic field penetration depth λ was determined from the muon spin relaxation rate σ measured in transverse external magnetic fields. The temperature dependence of λ indicates a predominantly finite energy gap. The systematic variation of λ leads to an approximately linear relation T/sub C/proportionalσproportional1/λ^2proportionaln/sub s//m^* between the transition temperature T/sub C/ and the carrier density n/sub s/, which suggests a high-energy scale for the pairing interaction.

1025 **Structural and electronic properties of WC.** Liu, A.Y.; Wentzcovitch, R.M.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 14, 9483-9489(15 Nov 1988).

We present the results of a pseudopotential local-orbital calculation on hexagonal WC. The calculated lattice constants and cohesive energy are in good agreement with experiment, and the calculated bulk modulus lies within the wide range of measured values. The band structure and Fermi surface obtained are also generally consistent with experimental data, and the Fermi level is found to lie in a deep minimum of the density of states. The calculated valence electron charge density indicates that the bonding in WC consists of a metallic component similar to that found in solid W, and strong W-C bonds.

1026 **Long-wavelength absorption of cermets.** Mahan, G.D. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996-1200). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 14, 9500-9502(15 Nov 1988).

Cermets are inhomogeneous materials composed of small metal spheres randomly distributed in a host dielectric. A theory is presented for the electromagnetic absorption at very long wavelength. The most important quantity is the magnetic permeability μ, even for nonmagnetic systems.

1027 **Electronic structure of stoichiometric and off-stoichiometric TaC/sub x/.** Schadler, G.H.; Boring, A.M.; Weinberger, P.; Gonis, A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 14, 9538-9544(15 Nov 1988).

We have determined the electronic structure of stoichiometric and substoichiometric TaC by means of the relativistic Korringa-Kohn-Rostoker Green's-function method. The introduction of vacancies was treated within the coherent-potential approximation. We find that the main difference between the ordered and disordered compound is a charge transfer from the nonmetal to the metal atom. Additional vacancy states (-3.0 eV below the Fermi energy) play a minor role. We calculate x-ray photoemission spectroscopy (XPS) intensities for both stoichiometric and substoichiometric cases and find (unlike previous calculations) excellent agreement with the XPS data. We also compare our results with the measured linear specific-heat coefficient and find that the sharp drop seen in this quantity with increasing vacancy concentration cannot be explained by our results.

1028 **Resonant photoemission in Ti_2O_3 and V_2O_3: Hybridization and localization of cation 3d orbitals.** Smith, K.E.; Henrich, V.E. (Applied Physics, Yale University, 15 Prospect Street, New Haven, Connecticut 06520). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 14, 9571-9580(15 Nov 1988).

Resonant photoemission from cation 3d and oxygen 2p states in both Ti_2O_3 and V_2O_3 single crystals has been observed as the photon energy is swept through the cation 3p→3d optical-absorption transition. These nonmaximal valency oxides are excellent materials in which to study the effect of a ligand environment on resonant photoemission from cation d states, due to the existence of partially occupied d states well separated from the O 2p states. This investigation has revealed complex new aspects of the electronic structure of these oxides and the phenomenon of resonant photoemission in them. The cation 3d resonant emission was found to display a strong angular anisotropy which could be related to the molecular-orbital structure of these oxides. The maximum in the cation 3d resonance emission occurs at the same photon energy in both the metals and oxides, indicating a significant degree of localization of the cation resonance. A strong resonance in the O 2p emission from Ti_2O_3 is observed as the photon energy is swept through the Ti 3p→3d transition. A much smaller resonance is seen in the O 2p emission from V_2O_3 at the V 3p→3d transition, despite an increase in d character in the O 2p band in V_2O_3. Thus caution must be used in extracting information on hybridization from resonant photoemission data.

1029 **Effect of an applied magnetic field on the abrupt donor collapse in a ferromagnetic semiconductor.** Hillery, M.S.; Emin, D.; Liu, N.H. (Department of Physics and Astronomy, Hunter College of the City University of New York, New York, New York 10021). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 14, 9771-9777(15 Nov 1988).

With rising temperature, the spin disorder of a ferromagnetic semiconductor can drive a donor electron to collapse from a large-radius state to a severely localized (small-polaronic) donor state. The application of a magnetic field suppresses the spin deviations and increases the temperature of the donor collapse. With weak magnetic fields, the temperature of the donor collapse is found to increase as the square root of the applied magnetic field. As a result of this sublinear dependence of the temperature of the donor collapse on magnetic field strength, the application of small magnetic fields can induce substantial increases of the temperature of the donor collapse. Furthermore, using the previously determined parameters for a donor in EuO, a magnetic field of 5 T produces an increase of the temperature of the donor collapse of over 10 K. The agreement of the calculated shift of the donor collapse with the observed shift of the temperature of the metal-to-insulator transition in heavily doped EuO is consistent with the proposal that the metal-to-insulator transition in heavily doped EuO is primarily caused by the donor collapse.

1030 **Molecular-dynamics investigation of hydrogen hopping in palladium.** Culvahouse, J.W.; Richards, P.M. (Department of Physics and Astronomy, University of Kansas, Lawrence, Kansas 66044). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 14, 10020-10031(15 Nov 1988).

Diffusive hopping of hydrogen in PdH/sub x/ has been reexamined with molecular-dynamics (MD) simulations in order to clarify earlier results of Gillan. We obtain the same values for the diffusion coefficient and width Γ/sub q/ of the quasielastic neutron scattering function when Gillan's potentials are used, but go beyond Gillan in performing a statistical analysis of the jumps. The analysis shows that over 95% of the jumps are uncorrelated and nearest neighbor, but the distribution of times between jumps is highly nonexponential. This latter feature accounts for the departure of Γ/sub q/, noted by Gillan, from the Chudley-Elliott (CE) theory based on simple one-step nearest-neighbor hopping. A simple physical model of the hopping as a two-step process can explain the results and suggests they are highly sensitive to the H-Pd potential at short distances. A new MD simulation with a harder-core potential gives a Γ/sub q/ in much better agreement with CE. We conclude that the

non-CE behavior originally found by Gillan might be seen in real experiments on systems with suitably soft potentials.

1031 **Electronic structure of MnO studied by angle-resolved and resonant photoemission.** Lad, R.J.; Henrich, V.E. (Applied Physics, Yale University, P.O. Box 2157, New Haven, Connecticut 06520). *Physical Review [Section] B: Condensed Matter;* **38**: No. 15, 10860-10869(15 Nov 1988).

Results are reported from angle-integrated, angle-resolved, and resonant photoemission measurements on cleaved MnO single crystals using synchrotron radiation. Normal-emission spectra from a cleaved (100) surface indicate that the relative dispersion of Mn 3d states in the valence band is less than +- 0.1 eV along Γ—Δ—X in the Brillouin zone, which supports the view of highly localized 3d electrons on the Mn/sup 2+/ cations. The results of polarization-dependent and off-normal-emission measurements are also consistent with a localized Mn 3d orbital picture. To explain the presence of satellite photoemission peaks, a hybridization between Mn 3d and O 2p valence states must be invoked. The degree of hybridization is evident from resonant-photoemission measurements at the Mn 3p→3d absorption threshold. The antiresonant behavior of the 3d-derived states near the top of the valence band in constant-initial-state spectra suggests that MnO is a charge transfer rather than a Mott insulator. The experimental results are discussed in the context of recent cluster and band theories which have been proposed to explain the insulating nature and electronic structure of MnO.

1032 **Optical and electron paramagnetic resonance studies of Fe impurities in yttrium aluminum garnet crystals.** Chen, C.Y.; Pogatshnik, G.J.; Chen, Y.; Kokta, M.R. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8555-8561(1 Nov 1988).

Optical-absorption and electron paramagnetic resonance (EPR) techniques were used to study iron impurities in yttrium aluminum garnet (YAG) crystals. Due to its low symmetry, YAG containing Fe/sup 3+/ exhibited many EPR lines. Fe/sup 3+/ ions in octahedral and tetrahedral sites were identified. A correlation study involving both EPR and optical-absorption measurements indicated that the absorption band at 255 nm, which had been previously attributed to an Fe/sup 3+/ charge-transfer band, was a composite charge-transfer band made up of contributions from substitutional Fe/sup 3+/ at both symmetry sites. Oxidation and reduction experiments up to 1700 K were performed. The former increased the Fe/sup 3+/ concentration, and the latter diminished it. Conversion of Fe/sup 2+/ to Fe/sup 3+/ was governed by a thermal activation energy of 3.0 +- 0.3 eV.

1033 **Nuclear-quadrupole induction of atomic polarization.** Sleator, T.; Hahn, E.L.; Heaney, M.B.; Hilbert, C.; Clarke, J. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8609-8624(1 Nov 1988).

Nuclear-quadrupole-induced electric signals are measured as a new resonance response mechanism that is the reciprocal of the Stark effect in magnetic resonance. In single crystals that have noncentrosymmetry with respect to the sites of precessing nuclear-quadrupole moments, the electronic polarizability of atoms and chemical bonds on opposite sides of the nuclear-quadrupole moment is not the same. The oscillating electric field produced by the quadrupole moment induces a net electric dipole moment in its neighboring electronic environment. The coherent summation of these dipole moments over the Boltzmann distribution of the nuclear ensemble produces an oscillating macroscopic electric dipole moment. The sample is placed between the plates of a capacitor that is tuned with an inductance to the nuclear precession frequency. Coherent nuclear precession is initiated following a rf magnetic field pulse that tips the nuclear spins into the precession mode. The voltage signal from the capacitor gives rise to an oscillating current in the series circuit and magnetic flux in the inductor. Stray magnetic induction pickup signals are balanced out. The flux is coupled to a dc superconducting quantum interference device (SQUID), which produces a voltage output at the nuclear-quadrupole resonance frequency of ~30 MHz for /sup 35/Cl nuclei in $NaClO_3$ at 4.2 K. The /sup 35/Cl nucleus induces electric dipole moments in nearby oxygen atoms bonded to the Cl atom. Measured free-precession electric signals are compared to the predictions of a point-oxygen-atom polarizability model applied to the Cl: O bond. The technique is sensitive to chirality and to bond angles.

1034 **Antiferromagnetic ordering of Cu ions in NdBa$_2$Cu$_3$O/sub 6.1/.** Moudden, A.H.; Shirane, G.; Tranquada, J.M.; Birgeneau, R.J.; Endoh, Y.; Yamada, K.; Hidaka, Y.; Murakami, T. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8720-8723(1 Nov 1988).

Neutron-scattering experiments performed on single crystals NdBa$_2$Cu$_3$O/sub 6.1/ reveal antiferromagnetic order for T<T/sub N/ = 385 +- 2 K in which the structure is characterized by the magnetic wave vector ((1/2,1)/2,(1/2); this had previously been observed only at low temperature in single crystals of YBa$_2$Cu$_3$O/sub 6+//sub x/ [the Y(1:2:3) compound]. The magnetic intensities are accounted for by Cu/sup 2+/ spins coupled antiferromagnetically in the CuO_2 planes as in the yttrium compounds YBa$_2$Cu$_3$O/sub 6+//sub x/ (x<0.5). However, unlike the Y(1:2:3) compound case, the oxygen-deficient planes in the Nd(1:2:3) compound exhibit small staggered magnetization εS which induces the spin ordering -S-εS-S+S+εS+S, along the tetragonal axis. The average staggered magnetization evaluated at room temperature is about 0.40μ/sub B/ in the CuO_2 planes while in the oxygen deficient (Cu-chain) layers it is about 0.04μ/sub B/. The exchange coupling between the Cu atoms in the oxygen deficient layer containing Cu chains and its nearest-neighbor CuO_2 layers (Cu planes) is thus ferromagnetic; this may be readily understood by consideration of the relevant Cu/sup 2+/ orbitals.

1035 **Crystal-field and exchange interactions of dilute Gd/sup 3+/ ions in Eu_2CuO_4.** Rao, D.; Tovar, M.; Oseroff, S.B.; Vier, D.C.; Schultz, S.; Thompson, J.D.; Cheong, S.; Fisk, Z. (Physics Department, San Diego State University, San Diego, California 92182). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8920-8922(1 Nov 1988).

We have measured the electron-spin-resonance spectrum of Gd/sup 3+/ ions substituting for Eu ions in Eu_2CuO_4. The fine structure of the spectrum was partially resolved at room temperature and the individual transitions were completely separated below 100 K. The spectrum is described with a crystal-field effective Hamiltonian of tetragonal symmetry. The values obtained at low temperatures for the corresponding parameters are b_2^0 = -486(7) x 10/sup -4/ cm/sup -1/, b_4^0 = -32(2) x 10/sup -4/ cm^{-1}, and chemical bondb_4'chemical bond = 790(50) x 10/sup -4/ cm/sup -1/. These parameters are only weakly temperature dependent. The measured effective g value is shifted from the free-ion value g = 1.992, indicating the existence of antiferromagnetic exchange interactions with the ions of the host.

1036 **Pressure-temperature phase diagram of γ-phase propylammonium tetrachloromanganate.** Moudden, A.H.; Vettier, C. (Laboratoire de Physique des Solides, Universite de Paris—Sud, F-91405 Orsay, France). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 9040-9043(1 Nov 1988).

The pressure (P) and temperature (T) phase diagram of propylammonium tetrachloromanganate (PAMC) is studied in the stability region of the incommensurate γ phase. Using neutron scattering, we measured the variation of the wave vector and the amplitude of the structural distortion as a function of P and T. The reentrant character of this phase is unambiguously established by applying a hydrostatic pressure up to 1200 bars. Above this limit the incommensurate γ phase is shown to be no longer stable. In the whole incommensurate region, the period of the modulation remains roughly independent of P and T, whereas its amplitude continuously increases from zero at the phase boundary. This is well accounted for by a parabolic contour line with a thermal-expansion—to—compressibility ratio of 28 bars/K.

1037 **Phase constitution and thermal expansion of $YBa_2Cu_3O_{7-\delta}$ single crystals.** You, H.; Axe, J.D.; Kan, X.B.; Hashimoto, S.; Moss, S.C.; Liu, J.Z.; Crabtree, G.W.; Lam, D.J. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 9213-9216(1 Nov 1988).

We present an x-ray diffraction study of $YBa_2Cu_3O_{7-\delta}$ single crystals. High-resolution scans reveal two orthorhombic phases with different lattice constants but a common orientation indicating a phase separation into phases with $\delta \cong 0.0$ and 0.3. Thermal expansions of the unit cell parameters of both phases measured between 10 and 300 K were fit using a quasi-harmonic approximation giving a best-fit Debye temperature of 370 +- 5 K. The measured orthorhombicities were found to change smoothly through the superconducting transition temperature without any anomaly.

1038 **Electronic correlations and satellites in superconducting oxides.** Chang, K.J.; Cohen, M.L.; Penn, D.R. (Xerox Corporation, Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, California 94304). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8691-8696(1 Nov 1988).

The satellite observed at binding energy of 12—13 eV below the Fermi level in the high-T_c oxide superconductors $La_{2-x}Sr_xCuO_4$ and $YBa_2Cu_3O_{7-\delta}$ is viewed as originating from a state with two holes bound at the same Cu site. As in the case of Ni metal, the satellite is caused by an intra-d-shell shakeup process into a Cu $3d^8$ final state and its intensity is enhanced at resonance because of a super-Koster-Kronig transition. Based on the t-matrix approach for the hole self-energy, we study the effect of electronic correlations on the one-electron band structure. We examine the position of the satellite and find a large Coulomb interaction energy of ~5 eV at the Cu site when the experimental satellite position is duplicated by the theory. Since this energy is comparable with the 3d bandwidth, the two-hole bound state is a high-energy excitation. This indicates that in the ground state a creation of two holes at the Cu site is unlikely and thus holes are formed at the O sites when Sr is substituted for La in La_2CuO_4 and when the oxidation is increased in $YBa_2Cu_3O_{7-\delta}$.

1039 **Magnetism and superconductivity in $(Er_{0.16}Ho_{0.84})Rh_4B_4$.** Pringle, O.A.; Mook, H.A.; Lambert, S.E.; Maple, M.B. (Solid State Division, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8724-8729(1 Nov 1988).

The superconducting and ferromagnetic phase boundaries in the $(Er_{1-x}Ho_x)Rh_4B_4$ mixed ternary alloy system meet in a multicritical point at $x_{cr} \cong 0.9$. For $x < x_{cr}$, the compounds first become superconducting as the temperature is lowered, and then lose superconductivity in a transition to ferromagnetism. The coexistence of superconductivity and ferromagnetism for alloys near the erbium-rich end of the phase diagram is well established. It has also been suggested that ferromagnetism and superconductivity coexist in alloys with x just below x_{cr}. We have carried out neutron-diffraction, ac magnetic susceptibility, and heat-capacity measurements on a sample of $(Er_{0.16}Ho_{0.84})Rh_4B_4$ to investigate the possibility of coexistence of ferromagnetism and superconductivity for $x \cong x_{cr}$. We find that there are minor discrepancies in the superconducting and magnetic transition temperatures reported for different samples of $(Er_{0.16}Ho_{0.84})Rh_4B_4$, but that ferromagnetism and superconductivity do occur simultaneously over a narrow temperature range in this sample. We suggest that an inhomogeneous state occurs, consisting of separate ferromagnetic and superconducting regions, rather than microscopic coexistence.

1040 **Mixed valency, hole concentration, and T_c in $YBa_2Cu_3O_{6+x}$.** Tranquada, J.M.; Heald, S.M.; Moodenbaugh, A.R.; Xu, Y. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8893-8899(1 Nov 1988).

Combining the assumptions that in orthorhombic $YBa_2Cu_3O_{6+x}$ oxygen is removed from the CuO chains one chain at a time and that the Cu atoms in the twofold coordinated sites of the empty chains have a valence of +1 leads to the prediction that the number of Cu^{1+} ions per unit cell is equal to 1-x. X-ray absorption measurements at the Cu K edge in both oriented and unoriented quenched samples with $0 < x \leqq 1$ confirm this prediction. Charge neutrality then requires that the number of O 2p holes per unit cell be equal to x. It follows that the superconducting transition temperature T_c should be proportional to x (rather than 2x-1), as observed in our quenched samples. Thus, the CuO chains, though not required for superconductivity, act as an electron reservoir which serves to maximize T_c when oxygen is removed. The nonlinear variation of T_c observed in annealed samples is explainable in terms of spinodal decomposition, as first suggested by Khachaturyan and Morris.

1041 **Neutron diffraction study of α-$MnC_2O_4x2D_2O$.** Mitsuda, S.; Simizu, S.; Lukin, J.; Friedberg, S.A.; Yang, B.X.; Shirane, G. (Institute for Solid State Physics, Univeristy of Tokyo, Tokyo 106, Japan). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 9035-9039(1 Nov 1988).

A neutron diffraction study of α-$MnC_2O_4x2D_2O$, a quasi-one-dimensional antiferromagnet with anisotropic interchain interactions, has been performed on powder specimens. It reveals two magnetically ordered phases at low temperatures. The upper phase below $T_N = 2.4$ K has an incommensurate helical spin structure with propagation vector Q = (0.170,(1/2,-0.025). A gradual transformation occurs below $T_2 = 1.5$ K, where a commensurate structure with a propagation vector Q = (0,(1/2,0) develops as the temperature falls, while evidence of the incommensurate structure diminishes.

1042 **Ion-channeling investigation of thermal vibrational amplitudes across the superconducting transition in $YBa_2Cu_3O_{7-\delta}$.** Sharma, R.P.; Rehn, L.E.; Baldo, P.M.; Liu, J.Z. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 9287-9290(1 Nov 1988).

Ion-channeling measurements reveal that the thermal vibrational amplitude, u_1, decreases markedly from 0.008 to 0.0056 nm as the temperature of orthorhombic single crystals of $YBa_2Cu_3O_{7-\delta}$ is lowered from 300 to 220 K. The rate of this decrease slows at lower temperatures, with u_1 reaching a value of 0.0042 nm at 100 K. Further cooling of the sample across the superconducting transition region (to 85 K) produces an abrupt, additional decrease in u_1 to 0.0035 nm. This abrupt lattice stiffening corresponds to an ~140 K increase in Debye temperature across the superconducting transition.

1043 **Field-induced magnetic form factor of La_2CuO_{4-y}.** Stassis, C.; Harmon, B.N.; Freltoft, T.; Shirane, G.; Sinha, S.K.; Yamada, K.; Endoh, Y.; Hidaka, Y.; Murakami, T. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 9291-9294(1 Nov 1988).

Polarized-neutron-scattering techniques have been used to study the spatial distribution of the induced magnetization (by a magnetic field of 50 kG) in a single crystal of La_2CuO_{4-y}. The induced-moment magnetic form factor was obtained by measuring at T = 330 K (>T_N = 304 K) the polarization ratios of eight Bragg reflections. The measured induced-moment magnetic form factor was found to be in good agreement with the 3d magnetic form factor of the Cu^{2+} free ion. This observation implies that if any moment is induced on the in-plane oxygen sites, it is certainly much smaller than that predicted from recent band-theoretical calculations.

1044 Pulsed laser deposition of thin superconducting films of $Ho_1Ba_2Cu_3O$/sub 7-//sub x/ and $Y_1Ba_2Cu_3O$/sub 7-//sub x/. Geohegan, D.B.; Mashburn, D.N.; Culbertson, R.J.; Pennycook, S.J.; Budai, J.D.; Valiga, R.E.; Sales, B.C.; Lowndes, D.H.; Boatner, L.A.; Sonder, E.; and others. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6056). *Journal of Materials Research;* 3: No. 6, 1169-1179(Nov 1988).

Thin films of $Ho_1Ba_2Cu_3O$/sub 7-//sub x/ and $Y_1Ba_2Cu_3O$/sub 7-//sub x/ were deposited on $SrTiO_3$ and Al_2O_3 substrates by pulsed laser deposition of high-T/sub c/ bulk superconductor pellets in vacuum. Following annealing in O_2 at 800—900 °C the films were superconducting with typical T/sub c/ (50%) = 89 K and transition widths of 10 K. Rutherford backscattering spectrometry (RBS) and secondary ion mass spectrometry (SIMS) were utilized to study the stoichiometry of the as-deposited films for laser energy densities between 0.11 and 4.5 J cm^{-2}. The films were deficient in holmium and yttrium for energy densities below 0.6 and 0.4 J cm^{-2}, respectively. The films were stoichiometric for fluences above 0.6 J cm^{-2}. In addition, preliminary time dependence and spectroscopic observations of the laser-produced plasma are presented. The results indicate an ablation mechanism that at high energy densities preserves stoichiometry. TEM and x-ray characterization of annealed, superconducting $Ho_1Ba_2Cu_3O$/sub 7-//sub x/ films on (100) $SrTiO_3$ showed mixed regions of epitaxially oriented 1:2:3 material with either the c axis or a axis oriented along the surface normal. The a-axis-oriented material grew preferentially in the films with b, c, twinning. $Y_1Ba_2Cu_3O$/sub 7-//sub x/

1045 Synthesis, characterization, and properties of nanophase TiO_2. Siegel, R.W.; Ramasamy, S.; Hahn, H.; Zongquan, L.; Ting, L.; Gronsky, R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Materials Research;* 3: No. 6, 1367-1372(Nov 1988).

Ultrafine-grained, nanophase samples of TiO_2 (rutile) were synthesized by the gas-condensation method and subsequent in situ compaction. The samples were studied by a number of techniques, including transmission electron microscopy, Vickers microharness measurements, and positron annihilation spectroscopy, as a function of sintering temperature. The nanophase compacts with average initial grain sizes of 12 nm were found to densify rapidly above 500 °C, with only a small increase in grain size. The hardness values obtained by this method are comparable to or greater than those for coarser-grained compacts, but are achieved at temperatures 400 to 600 °C lower than conventional sintering temperatures and without the need for sintering aids.

1046 Liquidus relations in Y—Ba—Cu oxides. Aselage, T.; Keefer, K. (Electronic Ceramics Division 1842 and Ceramics Development Division 1845, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Materials Research;* 3: No. 6, 1279-1291(Nov 1988).

The liquidus relations in the system YO/sub 1.5/—BaO—CuO/sub x/ in air in the compositional region near the superconducting oxide YBa_2Cu_3O/sub x/ were studied by differential thermal analysis, x-ray diffraction, electron microprobe analysis, and visual observation. The temperatures of 11 invariant points and the corresponding reactions were determined. YBa_2Cu_3O/sub x/ was found to melt incongruently at 1015 °C to Y_2BaCuO_5, which in turn melts incongruently to Y_2O_3 at 1270 °C. These reactions mean that preparing the superconducting phase by melting and rapid cooling will result in the presence of these two phases as well. The peritectic reaction YBa_2Cu_3O/sub x/ + $CuO \rightarrow Y_2BaCuO_5$ + liquid at 940 °C accounts for the observation of partial melting, improved synthesis purity, and grain growth at temperatures of 950 °C. The determination of these invariant temperatures and reactions provide insight into optimal processing conditions.

1047 Structural characterization of La/sub 2-//sub x/M/sub x/CuO_4 (M = Sr,Ba) samples by synchrotron x-ray and neutron powder diffraction techniques. Cox, D.E.; Moss, S.C.; Meng, R.L.; Hor, P.H.; Chu, C.W. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Materials Research;* 3: No. 6, 1327-1335(Nov 1988).

High-resolution synchrotron x-ray powder diffraction studies on samples of La/sub 2-//sub x/M/sub x/CuO_4 (M = Sr,Ba) prepared by standard ceramic techniques show that macroscopic compositional inhomogeneities may exist that are unlikely to be revealed by conventional x-ray diffraction methods. Rietveld refinement of neutron data collected at 200, 50, and 11 K from one such sample, nominally La/sub 1.8/Sr/sub 0.2/CuO_4, gave satisfactory fits to a tetragonal structure of K_2NiF_4 type at all three temperatures. However, careful individual peak fits revealed that part of the sample transforms to orthorhombic between 200 and 50 K. It is suggested that this multiphase character has an important influence on the superconducting properties.

1048 Electron microscopy study of the atomic structure of a mullite in a reaction-sintered composite. Schryvers, D.; Srikrishna, K.; O'Keefe, M.A.; Thomas, G. (National Center for Electron Microscopy, MCSD, Lawrence Berkeley Laboratory and Department of Materials Science and Mineral Engineering, University of California, Berkeley, California 94720.). *Journal of Materials Research;* 3: No. 6, 1355-1361(Nov 1988).

The mullite matrix of a reaction-sintered mullite/zirconia composite has been characterized by various electron microscopy techniques. The mullite was determined to be stoichiometrically Al/sub 4.76/ Si/sub 1.23/ O/sub 9.61/ (1.7:1 mullite) with a disordered vacancy structure and Pbam symmetry. The atomic structure of the mullite has been described in terms of an average unit cell.

1049 Friction and wear studies in N-implanted Al_2O_3, SiC, TiB_2, and B_4C ceramics. Nastasi, M.; Kossowsky, R.; Hirvonen, J.; Elliott, N. (Los Alamos National Laboratory, Materials Science and Technology Division, Los Alamos, New Mexico 87545). *Journal of Materials Research;* 3: No. 6, 1127-1133(Nov 1988).

Bulk polycrystalline samples of sintered Al_2O_3, and hot-pressed Al_2O_3, SiC, TiB_2, and B_4C ceramics were ion implanted at 77 K with 190 keV N^+ to a dose of 3 x 10^{17} N/cm^2. Nitrogen implantation resulted in reduced friction coefficients for SiC, TiB_2, and B_4C samples and a reduction in wear for TiB_2. Both Al_2O_3 samples showed a significant increase in friction coefficients after nitrogen implantation. Nitrogen-implantation-induced changes in these properties appear to be correlated with the thermodynamic tendency of the sample to form "nitridelike" bonds.

1050 (N—88-25496) Mass spectrometric high temperature measurements of the barium oxide-zirconium dioxide system and the determination of thermodynamic data for barium zirconate. Odoj, R.; Hilpert, K. (National Aeronautics and Space Administration, Washington, DC (USA)). Jun 1988. Translation of Massenspektrometrische Hochtemperatur Messung des Systems BaO-ZrO2 und Bestimmung Thermodynamischer Daten des BaZrO3. Ein Beitrag zur Klaerung des Rueckhaltevermoegens Beschichteter...Oct. 1975 p 1-101. (NASA-TT—20187; NAS—1.77:20187). 121p. NTIS, PC A06/MF A01.

Retention of fission products in reaction processes of fission products and mass spectrometric high temperature measurements with a Knudsen cell, general part, are discussed. Calculation of thermodynamic quantities from the measurements to determine the reaction enthalpy according to the Second Law of Thermodynamics, calculation of the reaction enthalpy from the third Law of Thermodynamics and calculation of the specific heat and entropy of $BaZrO_3$ from $BaTiO_3$ are presented.

1051 Theoretical studies of copper oxide clusters: Prediction of an electronically driven phase separation in YBa/sub 2/Cu/sub 3/O/sub chi/. Curtiss, L.A.; Brun, T.O.; Gruen, D.M. (Chemical Technology Div./Materials Science Div./Chemistry Div., Argonne National Lab., Argonne, IL (US)). pp 95-100 of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

On the basis of semi-empirical extended Huckel molecular orbital calculations of copper-oxide clusters representing the new superconducting material YBa/sub 2/Cu/sub 3/O/sub chi/, a phase diagram is proposed which suggests that the 94 K high temperature superconducting phase of YBa/sub 2/Cu/sub 3/O/sub chi/, is characterized by an oxygen stochiometry near 7.0. The phase diagram predicts that a plateau should exist for T/sub c/ in the region chi = 0.0 - 0.25 and that is this region two phases are present which are characterized by compositions having oxygen stoichiometries 6.5 - 6.75 and ca. 7.0.

1052 **Thermal-wave imaging of ceramic/metal boundaries and of voids in low and high thermal conductivity ceramics.** No, K.; McClelland, J.F. (Iowa State Univ., Ames (USA)). pp 263-272 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Laser excited thermal-wave magnitude and phase images were acquired by photoacoustic detection in the 10 to 1000 Hz range on voids in ceramics and on epoxy/aluminum interface systems with surface and bulk laser absorbing epoxy and different planar interface distances. Thermal-wave images were more directly interpretable for the voids in ceramics and epoxy/aluminum interface which absorb light at the irradiated surface rather than in the bulk because the bulk-generated thermal-wave signal also involved light reflection at the interface. The observed data were consistent with thermal diffusion length and thermal wave propagation effects predicted by theory for surface light absorption conditions.

1053 **Nondestructive characterization of ceramic composite whiskers with neutron diffraction and ultrasonic techniques.** Kupperman, D.S.; Majumdar, S.; MacEwen, S.R.; Hitterman, R.L.; Singh, J.P.; Roberts, R.A.; Routbort, J.L. (Argonne National Lab., IL (USA)). pp 961-969 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-31-109-ENG-38.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The General Purpose Powder Diffractometer at the Intense Pulsed Neutron Source at Argonne National Laboratory was employed to measure residual strains in a ceramic-ceramic composite using neutron diffraction techniques. The residual strain measurements were used to calculate stresses at the fiber-matrix interface. The results of the residual strain experiment and the initial results from experiments in which ultrasonic techniques were used to assess whisker-matrix bonding are discussed. Ceramics tested included alumina, silicon nitride, and silicon carbide. Thermal expansion coefficients were also determined.

1054 **Ultrasonic characterization of ceramic-ceramic composites.** Walter, J.B.; Lott, L.A.; Telschow, K.L. (EG & G Idaho, Inc., Idaho Falls (USA)). pp 971-978 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC07-76ID01570.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Experimental techniques were developed to measure ultrasonic wave propagation velocity and attenuation in a set of SiC/SiC composites. Ultrasonic properties were measured in through-transmission at frequencies below 5 MHz using both standard piezoelectric and laser ultrasonic pulse generation. Better spatial resolution was achieved using the laser technique because the higher ultrasonic energy densities in the SiC samples permitted the use of a smaller receiving transducer. Ultrasonic attenuation and velocity showed strong correlation to material porosity. The degree of scatter found in the data indicated, however, that other factors also significantly influenced the propagation of ultrasonic energy through these composites.

1055 **Imaging subtle microstructural variations in ceramics with precision ultrasonic velocity and attenuation measurements.** Generazio, E.R.; Roth, D.J.; Baaklini, G.Y. (National Aeronautics and Space Administration, Cleveland, OH (USA)). pp 1237-1246 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Acoustic images of silicon carbide ceramic disks were obtained using a precision scanning contact pulse echo technique. Phase and cross-correlation velocity and attenuation maps were used to form color images of microstructural variations. The images revealed microstructural variations not observable with x-ray radiography.

1056 **Ultrasonic characterization of microspherical inclusions in zirconia and crystallized glass.** Stockman, A.; Nicholson, P.S. (McMaster Univ., Hamilton, Ontario (Canada)). pp 1273-1283 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A mathematical model was developed which calculates waveforms and frequency spectra for sound waves scattered from various sized inhomogeneities as a function of the host and inclusion material parameters and the spectrum of the incoming waves. The model is based on the work of Ying and Truell and was modified to incorporate a focused ultrasonic beam to increase the power and a pulsed system for locating the defect. The model was first tested on voids in a glass matrix. Spherical oxide particles were then embedded in the glass. The glass was next crystallized to approximate a real ceramic. Spherical particles of platinum were also embedded in dense zirconia. Backscattered signals were compared with model predictions.

1057 **La/sub 1/Ba/sub 2/Cu/sub 3/O/sub 9-δ/: Structural analysis as determined by neutron diffraction.** Golben, J.P.; Song, Y.; Chittipeddi, S.; Lee, S.I.; McMichael, R.D.; Chen, X.D.; Gaines, J.R.; Cox, D.L.; Epstein, A.J. (Dept. of Physics, The Ohio State Univ., 174 W. 18th Ave., Columbus, OH (US)). pp 895-898 of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

The La-Ba-Cu-O system contains several phases of special interest in the field of high Tc superconductivity. Specifically intriguing is the La/sub 3-x/Ba/sub 3+x/Cu/sub 6/O/sub 14+y/ ("3-3-6") phase, the La/sub 1.85/Ba/sub 15/CuO/sub 4/ ("K/sub 2/NiF/sub 4/") phase with a zero resistance temperature (Tc) of about 20 K, and the La/sub 1/Ba/sub 2/Cu/sub 3/O/sub 9-δ/ ("1-2-3") phase with Tc's reported up to 75 K. It has been suggested that the "3-3-6" phase may also be superconducting, especially in a Ba-doped version such that the stoichiometry is 2-4-6. In addition to defining a new high temperature superconducting phase, this later suggestion would also rule out the possibility of Cu-O "chains" being important to 90 K superconductivity since these chains are absent in the proposed configuration of this phase. The authors have performed neutron diffraction studies on two samples of composition La/sub 1/Ba/sub 2/Cu/sub 3/O/sub 9-δ/ with Tc = 26 K and 43 K. Our results demonstrate that the 3-3-6 phase, if present, exists in very small amounts. Both samples are tetragonal to within experimental error. They have also observed the diffraction peaks to sharpen as Tc is raised, implying increasing order in the placement of the La/Ba ions and/or oxygen vacancies. As found in the related Y/sub 1/Ba/sub 2/Cu/sub 3/O/sub 9/ compound, these results suggest that Tc increases as the oxygen vacancies tend toward ordering in lines.

1058 **Bulk superconductivity in La/sub 2/CuO/sub 4/.** Schirber, J.E.; Venturini, E.L.; Morosin, B.; Kwak, J.F.; Ginley, D.S.; Baughman, R.J. (Sandia Nat. Labs., Albuquerque, NM (US)). pp 479-482 of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

There is considerable interest in the interplay of superconductivity and magnetism in La/sub 2/CuO/sub 4/. Several groups have noted signs of superconductivity in nominal La/sub 2/CuO/sub 4/ and antiferromagnetism has been reported in La/sub 2/CuO/sub 4-y/ with y>0. The superconductivity previously reported was of a filamentary nature because although resistance drops to near zero were observed, only small Meissner effects (—10/sup -3/ to 10/sup -4/ of perfect diamagnetism) were observed. In this paper the authors describe our studies of ceramic samples of La/sub 2/CuO/sub 4-y/ loaded with oxygen by high pressure. This technique results in substantial incorporation of O/sub 2/ in the material (of the order of 0.3 to 0.4% by weight) and in gross changes in the bulk resistivity and magnetization as well as discernable changes in the lattice parameters of the material. The samples were formed by grinding stoichiometric amounts of La/sub 2/O/sub 3/ and CuO powders (Aeasar 99.999% reagents) in an agate mortar and air sintering for 45 hours at 1100°C followed by a 900°C O/sub 2/ anneal for 12 hours and a slow cool. This produces a black dense material which scanning electron micrograph and energy dispersive x-ray analysis showed to be comprised of rounded 20-30μ grains of stoichiometrically uniform La/sub 2/CuO/sub 4/ with no detectable impurities. Grain to grain interfaces were distinct with pronounced linear grain boundaries. This as prepared material showed less than 0.1% superconductivity from Meissner effect measurements in a SHE SQUID magnetometer. The resistive transition was sharp with zero resistance near 30K and a room temperature resistivity of —125mΩ cm.

1059 **Reentrant softening in copper-oxide superconductors.** Violet, C.E.; Datta, T.; Ledbetter, H.M.; Almasan, C.; Estrada, J. (Lawrence Livermore Nat. Lab., Livermore, CA (US)). pp 375-378 of High-temperature superconductors. Brodsky, M.B.; Dynes, R.C.; Kitazawa, K.; Tuller, H.L. Pittsburgh, PA; Materials Research Society (1988). (CONF-8711114—).

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

On the basis of the reentrant-softening model, sound-velocity results in La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ and YBa/sub 2/Cu/sub 3/O/sub 7-x/ are shown to be neither dissimilar nor inconsistent with thermodynamic requirements. In both materials, as temperature decreases, the lattice softens just above T/sub c/. Below T/sub c/, this softening is offset by increased stiffness associated with the developing superconducting phase. This model agrees with results from other physical-property measurements, and it predicts that elastic stiffness is higher in the normal state than in the superconducting state. Recently reported sound-velocity measurements in the perovskite-like superconductors La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ and YBa/sub 2/Cu/sub 3/O/sub 7-x/ appear to be anomalous as well as qualitatively different. The La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ results indicate elastic softening at temperatures near T/sub c/, whereas the YBa/sub 2/Cu/sub 3/O/sub 7-x/ results give no such indication. Below T/sub c/, the increases in the bulk modulus and the elastic stiffness with decreasing temperature in these materials have been reported to be anomalous and inconsistent with thermodynamic requirements. The La/sub 1.85/Sr/sub 0.15/CuO/sub 4/ and YBa/sub 2/Cu/sub 3/O/sub 7-x/ results raise two issues. First, since the normal-superconducting transition is second order, general macroscopic thermodynamics requires the elastic bulk modulus to soften for temperatures at and below T/sub c/. Second, stiffening with no associated softening is difficult to reconcile with Mossbauer-spectroscopy measurements, which indicate lattice softening below T/sub c/ in EuBa/sub 2/(Cu/sub 1-y/Sn/sub y/)/sub 3/O/sub 7-x/. Also, it is difficult to reconcile with reasonable values of model parameters such as the Debye temperature, θ/sub D/, which affects the electron-phonon coupling constant.

1060 **Synthesis of ultrafine powders by microwave heating.** Meek, T.T.; Sheinberg, H.; Blake, R.D. US Patent Application 6-041,950. 24 Apr 1987. 11p. Contract W-7405-ENG-36. NTIS, PC A02/MF A01.

A method of synthesizing ultrafine powders using microwaves is described. A water soluble material is dissolved in water and the resulting aqueous solution is exposed to microwaves until the water has dissolved. The resulting material is an ultrafine powder. This method can be used to make Al_2O_3, NiO {plus} Al_2O_3 and NiO as well as a number of other materials including $GaBa_2Cu_3O$/sub x/. 1 tab.

3606 Other Materials

REFER ALSO TO CITATION(S) 221, 222, 445, 460, 461, 583, 807, 827, 842, 859, 941, 943, 948, 952, 953, 987, 1188, 1236, 1257, 1316, 1326, 1339, 1340, 1341, 1344, 1349, 1351, 1353, 1356, 1361, 1364, 1365, 1366, 1366, 1368, 1370, 1372, 1391, 1394, 1406, 1406, 1409, 1411, 1412, 1413, 1414, 1415, 1415, 1416, 1417, 1424, 1441, 1442, 1445, 1446, 1448, 1453, 1468, 1468, 1539, 1579, 1596, 2456, 2643

1061 (ACIESP—60-Vol.1, pp 1) **Pulse radiolysis study on polymers.** Tabata, Y. (Tokyo Univ. (Japan). Faculty of Engineering). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1062 **(AD-A—195693/7/XAB) Processing technology research in composites. Final report, 1 October 1986-30 September 1987.** Diefendorf, R.J. (Rensselaer Polytechnic Inst., Troy, NY (USA)). 31 Dec 1987. 6p. NTIS, PC A02/MF A01.

Chemical vapor deposition has been used for over fifteen years for depositing carbon matrices in carbon/carbon composites used for reentry nose tips, rocket nozzle throat inserts, and aircraft brakes. The same technology is appropriate for depositing silicon carbide or other matrices in ceramic-ceramic composites, or ceramic/carbon composites. Furthermore, chemical vapor deposition is a powerful technique for applying the graded oxidation-resistant coatings required for carbon/carbon composites in long-time oxidizing environments. Modern instrumentation allows many variations in properties to be made which had been impossible in the past. It is for these reasons that the author proposed the acquisition of a state-of-the-art low-pressure chemical-vapor-deposition apparatus.

1063 **(AD-A—195998/0/XAB) Longitudinal electrical conductivity of metal-matrix composites at cryogenic temperature in the presence of a longitudinal magnetic field. Part 1. Solution of the linearized Boltzmann equation. Part 2. Application of the solution to metal matrix composites.** Roig, F.S.; Schoutens, J.E. (Metal Matrix Composites Information Analysis Center, Santa Barbara, CA (USA)). 1987. 21p. (MMCIAC—000702). NTIS, PC A03/MF A01.

Pub. in Jnl. of Materials Science, Vol. 22, 3749-3754 and 4002-4010(1987).

The Boltzmann equation is solved in the relaxation time approximation with parallel E and B fields parallel to the continuous fibres reinforcing a metal matrix. It is shown that this solution is identical to that described elsewhere, except for the addition of the cyclotron frequency. The addition of the cyclotron-frequency term shows that the electrons follow helical paths as they drift down the composite. The boundary considered is either the external or the internal surface of a cylinder representing the fibre. To apply this solution to metal-matrix composite materials we assumed that the cylindrical fibres are non-conducting cylinders in a matrix of pure crystalline metal. The electron mean free path is never greater than half the fibre separation distance. In a companion paper we discuss the application of this solution to metal-matrix composites. Keywords: Metal matrix composites, Fiber reinforced composites, Linearized Boltzmann equation.

1064 **(AD-A—195999/8/XAB) Some theoretical considerations of the surface tension of liquid metals for metal matrix composites. Technical paper.** Schoutens, J.E. (Metal Matrix Composites Information Analysis Center, Santa Barbara, CA (USA)). May 1988. 27p. (MMCIAC—000701). NTIS, PC A03/MF A01.

This paper presents a model for calculating the surface tension of pure metals and their alloys. It is based upon the theory of Eyring et al which uses classical statistical physics to describe the thermodynamic properties of metals in the liquid state. Calculations show the surface tension of pure aluminum to be nearly 9 percent greater than that measured for pure aluminum having a monolayer of aluminum oxide (Al_2O_3), is within about 10% of measured values for Al-xMg and Al-xCu, where x is the weight percent of the alloying element. The model was also used to calculate the temperature coefficient. For pure aluminum the calculated values fall within experimental measurements, and exhibit a slight temperature dependence. Cast metal composite (MMC) materials reinforced with unidirectional fibers will turn out to be a low-cost alternative to MMC fabrication by diffusion bonding, cold and hot compaction, and other methods.

1065 **(AD-A—196011/1/XAB) Virtues of composite structures in electrode modification. Preparation and properties of poly(aniline)/nafion composite films. Technical report No. 3, September 1987-June 1988.** Orata, D.O.; Buttry, D.A. (Wyoming Univ., Laramie (USA). Dept. of Chemistry). 9 Jul 1988. 29p. NTIS, PC A03/MF A01.

Poly(aniline) (PA) is electropolymerized within thin films of precast Nafion on gold or glassy carbon electrodes. The quartz crystal microbalance (QCM) is used to aid in identification of the ionic species that undergo transport during switching of the PA between its insulating and conducting forms. The QCM frequency changes observed in solutions containing various cationic species suggest that cation transport is dominant for these composite structures. In acidic solution, a consequence of the high transport number for the proton in the composite films is shown to be an enhanced switching rate relative to the simple (non-composite) PA film. The composite PA films appear to be less resistive and therefore more electrochemically well behaved over a wider pH range than the simple PA films.

1066 **(AD-A—196215/8/XAB) Optical and structural characteristics of heavily boron-implanted CdTe. Technical report.** Bowman, R.C.; Alt, R.L.; Adams, P.M.; Knudsen, J.F.; Jamieson, D.M. (Aerospace Corp., El Segundo, CA (USA). Laboratory Operations). 24 May 1988. 30p. (TR—0086A(2945-07)-4). NTIS, PC A03/MF A01.

Cadmium telluride single crystals were subjected to multiple-energy boron-ion implants with total doses up to 1.5 x 10 sq cm. Various diagnostic techniques were used to assess the structural and electronic properties of these crystals in their as-implanted condition and after anneals under vacuum. The degradation of crystallinity following the boron implants was clearly evident. Annealing temperatures up to 500 C were not effective removing the damage from these heavy dose implants. The chosen boron implant conditions and annealing procedures have not produced substitutional boron donor centers. Excellent correlations were obtained for model calculations of boron projected range and implant damage profiles with the corresponding experimental parameters.

1067 **(BNL—41736) Highly ordered thin films of polyheterocycles: A synchrotron radiation study of polypyrrole and polythiophene Langmuir-Blodgett films.** Skotheim, T.A.; Yang, X.Q.; Chen, J.; Hale, P.D.; Inagaki, T.; Samuelson, L.; Tripathy, S.; Hong, K.; Rubner, M.F.; den Boer, M.L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-880669—23). NTIS, PC A02/MF A01. Order Number DE89001107/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

Langmuir-Blodgett films have been made with 3-n-hexadecylpyrrole and 3-n-octadecylpyrrole monomers and copolymers with unsubstituted pyrrole made by chemical polymerization at the air-water interface on a subphase containing $FeCl_3$. Langmuir-Blodgett films consisting of mixtures of stearic acid and alkylsubstituted polythiophenes have also been made as bilayer films. The orientation of single and multilayer films on platinum substrates have been studied by Near Edge X-ray Absorption Fine Structure Spectroscopy which also gives information about charge transfer interactions between the aromatic groups and the metallic substrates. The alkyl-substituted pyrroles form highly ordered two-dimensional structures. $FeCl_3$ initiated copolymerization with unsubstituted pyrrole leads to a more disordered system. In the case of polythiophene-stearic acid bilayers, the stearic acid layers are highly ordered. The poly(alkyl thiophene) layers sandwiched between stearic acid layers, on the other hand, exhibit random orientation of the thiophene moieties. 15 refs., 3 figs., 3 tabs.

1068 **(BNL—41740) A FTIR and NEXAS study of polypyrrole Langmuir-Blodgett films.** Yang, X.Q.; Chen, J.; Hale, P.D.; Inagaki, T.; Skotheim, T.A.; Okamoto, Y.; Samuelsen, L.; Tripathy, S.; Hong, K.; Rubner, M.F.; denBoer, M.L. (Brookhaven National Lab., Upton, NY (USA); Polytechnic Univ., Brooklyn, NY (USA). Dept. of Chemistry; Lowell Univ., MA (USA). Dept. of Chemistry; Massachusetts Inst. of Tech., Cambridge (USA); Hunter Coll., New York (USA). Dept. of Physics). 1988. Contract AC02-76CH00016. 7p. (CONF-880669—19). NTIS, PC A02/MF A01. Order Number DE89001092/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

3n-hexadecylpyrrole and 3-n-octadecylpyrrole have been synthesized, and Langmuir Blodgett films of these compounds have been studied by means of NEXAFS and FTIR spectroscopy. By comparing the spectra of two different polarizations, it was found that the hydrocarbon chains are normal to the substrate surface for LB films with multi-layers. For the monolayer LB films, the hydrocarbon tails are tilted towards the substrate surface due to the interaction between the pyrrole ring and the platinum substrate. 7 refs., 5 figs., 2 tabs.

1069 **(CONF-881125—1) Tailoring of properties of SiC whisker-oxide matrix composites.** Tiegs, T.N. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01. Order Number DE88016344/JAW.

From 3. international symposium on ceramic materials and components for engines; Las Vegas, NV, USA (27 Nov 1988).

Alumina and mullite reinforced with SiC whiskers have shown improved toughness and strength. The improvements are a result of crack-whisker interactions, such as crack bridging and deflection. The effectiveness of the interactions has been found to be functions of both the whisker physical characteristics and the surface chemistry. The important physical characteristics discussed are the diameter of the whiskers as well as the extraneous particulates associated with them. The whisker surface chemistry influences the bonding at the whisker-matrix interface. High toughness is observed when the bonding is limited and debonding can occur along the interface during crack propagation. 13 refs., 7 figs., 1 tab.

1070 **(CONF-8808133—2) Infrared reflectance measurement of ion implanted silica.** Magruder, R.H. III; Morgan, S.H.; Weeks, R.A.; Zuhr, R. (Belmont Coll., Nashville, TN (USA). Dept. of Physics; Fisk Univ., Nashville, TN (USA). Dept. of Physics; Vanderbilt Univ., Nashville, TN (USA). Dept. of Materials Science; Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01. Order Number DE89001702/JAW.

From SPIE conference on underwater imaging; San Diego, CA, USA (15 Aug 1988).

Infrared reflectance spectra of silica glass implanted with Ti, Cr, Mn, Fe, and Bi to doses between 0.5 - 6 {times}10^{16} cm/sup {minus}2/ have been measured from 5000 cm/sup {minus}1/ to 400 cm/sup {minus}1/ at room temperature. The ion energy of the implantation was 160 keV and the current was 10μA. Alterations in reflectance of bands at 1125 and 481 cm/sup {minus}1/ in the spectrum of an unimplanted sample of the order of 20% are observed. A band attributed to non-bridging oxygen ions at {approximately}1015 cm/sup {minus}1/ is observed to increase in intensity with increasing dose for all species. The band at 1125 cm/sup {minus}1/ is observed to shift to lower wavenumber with implantation. Bands

due to implanted ion-oxygen vibrations were not detected. The magnitudes of the effects on the existing bands were ion specific. This ion specificity is attributed to the differing chemical states of the implanted ions after implantation. 15 refs., 8 figs.

1071 **(DOE/PC/90959—T7) Microscopic modeling of sound waves in granular material: Quarterly project report, July 1, 1988-September 30, 1988.** Haff, P.K. (Duke Univ., Durham, NC (USA). School of Engineering). 1988. Contract FG22-86PC90959. 2p. NTIS, PC A02/MF A01. Order Number DE89002258/JAW.

During the past quarter we have made some important discoveries concerning the microstructure of loaded granular assemblies and its relation to the transmission of acoustic waves. Results are briefly discussed.

1072 **(DPST—86-372) Viscosity and resistivity of waste glasses.** Jantzen, C.M.; Plodinec, M.J. (Savannah River Lab., Aiken, SC (USA)). 10 Apr 1986. Contract AC09-76SR00001. 13p. NTIS, PC A03/MF A01. Order Number DE89002445/JAW.

Recently, Corning Glass analyzed the viscosity and electrical resistivity of simulated waste glasses. Additional viscosity data were provided by Sharp-Schurtz (S-S). The glasses tested included both sludge-only and precipitate hydrolysis compositions, and spanned the full range of sludge compositions expected in the DWPF. Several conclusions can be drawn at once from the data: The measured viscosities and resistivities are well correlated, i.e., if the viscosity is known, then the resistivity can be accurately inferred. The resistivities, particularly at melter startup temperatures, are rather insensitive to glass composition. Thus, changes in glass composition are not likely to significantly affect melter startup. The Corning and Sharp-Schurtz data sets are well correlated though not identical. The S-S viscosity data are probably more accurate, because of better sample preparation. Correlation of the viscosities with the composition of the glass will be pursued. 5 refs., 3 figs., 4 tabs.

1073 **(Juel—2176) Amorphization of pure gallium - laser quenching and low temperature ion beam irradiation in comparison with other methods.** Froehlingsdorf, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Koeln Univ. (Germany, F.R.)). Jan 1988. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755416/JAW.

Gallium is the only pure metal that can be amorphized in the absence of any second stabilizing element. Laser quenching of Ga-films at temperatures below 16 K, the crystallization temperature of amorphous Gallium (a-Ga), provides a-Ga out of both α- and β-crystalline Ga. Low temperatures not only are necessary to obtain high quenching rates but also to stabilize the amorphous phase. a-Ga prepared by laser irradiation at temperatures higher than 16 K is unstable and has a certain 'lifetime' that decreases with increasing temperature. Transient conductance measurements of laser melting and quenching of Gallium highlight some of the important features of rapid solidification. For the first time the lower part of the C-shaped transition curve in a TTT-diagram can be measured for a pure metal. Experimental results can be explained in terms of a nucleation model showing good agreement with results of more conventional quenching processes.

1074 **(LBL—25268) Structure and bonding of diamond and diamond-like materials: Microanalytical characterization at high spatial resolution.** Krishnan, K.M.; Blake, D.F.; Freund, F.; Lipari, R.J. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 13p. (CONF-880408—38). NTIS, PC A03/MF A01. Order Number DE89001254/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

We summarize the results of our studies of explosively compacted diamond particles, microwave plasma enhanced CVD diamond films and diamond-like residues of extraterrestrial carbon (Cδ residue) by microdiffraction, energy dispersive x-ray spectroscopy and electron energy-loss spectroscopy, all using nanometer-scale electron probes and by electron spectroscopy for chemical analysis, a complementary bulk spectroscopic method. However, the characterization of the Cδ residue is particularly emphasized. 7 refs., 5 figs.

1075 **(N—88-23838) Strain intensity factor approach for predicting the strength of continuously reinforced metal matrix composites.** Poe, C.C. Jr. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). May 1988. 38p. (NASA-TM—100617; NAS—1.15:100617). NTIS, PC A03/MF A01.

A method was previously developed to predict the fracture toughness (stress intensity factor at failure) of composites in terms of the elastic constants and the tensile failing strain of the fibers. The method was applied to boron/aluminum composites made with various proportions of 0 to + or - 45 deg plies. Predicted values of fracture toughness were in gross error because widespread yielding of the aluminum matrix made the compliance very nonlinear. An alternate method was developed to predict the strain intensity factor at failure rather than the stress intensity factor because the singular strain field was not affected by yielding as much as the stress field. Strengths of specimens containing crack-like slits were calculated from predicted failing strains using uniaxial stress-strain curves. Predicted strengths were in good agreement with experimental values, even for the very nonlinear laminates that contained only + or - 45 deg plies. This approach should be valid for other metal matrix composites that have continuous fibers.

1076 **(N—88-24242) Materials science with muon spin rotation. Annual report, 1 March 1987-29 February 1988.** (Virginia State Univ., Petersburg (USA)). Feb 1988. 92p. (NASA-CR—182891; NAS—1.26:182891). NTIS, PC A05/MF A01.

During this reporting period, the focus of activity in the Materials Science with Muon Spin Rotation (MSMSR) program was muon spin rotation studies of superconducting materials, in particular the high critical temperature and heavy-fermion materials. Apart from these studies, work was continued on the analysis of muon motion in metal hydrides. Results of these experiments are described in six papers included as appendices.

1077 (N—88-24242, pp 15) **Systematic variation of magnetic-field penetration depth in high-T(c) superconductors studied by muon spin relaxation.** Uemura, Y.J.; Emery, V.J.; Moodenbaugh, A.R.; Suenaga, M.; Johnston, D.C.; Jacobson, A.J.; Lewandowski, J.T.; Brewer, J.H.; Kiefl, R.F.; Kreitzman, S.R. (Tri-Univ. Meson Facility, Vancouver, British Columbia (Canada)). Feb 1988. NTIS, PC A05/MF A01. (NASA-CR—182891; NAS—1.26:182891).

In Materials science with such spin rotation. Annual report, 1 March 1987-29 February 1988.

The muon relaxation rate (sigma) was measured in the high critical temperature superconductors $YBa_2Cu_3O(x)$ for x = 6.66, 6.95, 7.0, and La1.85 Sr0.15 CuO_4 in transverse external magnetic fields 1 is approximately 4kG. A simple relation is found which connects the transition temperature T(c), the magnetic field penetration depth lambda(L), the carrier concentration n(s) and the effective mass m* as T(c) varies as sigma which varies as 1/lambda(L) squared which varies as n(s)/m*. The linear dependence T(c) varies as n(s)/m* suggests a high energy scale for the coupling between superconducting carriers.

1078 (N—88-24242, pp 14) **Coexisting static magnetic ordering and superconductivity in CeCu/sub 2.1/Si2 found by muon spin relaxation.** Uemura, Y.J.; Kossler, W.J.; Yu, X.H.; Schone, H.E.; Kempton, J.R.; Stronach, C.E.; Barth, S.; Gygax, F.N.; Hitti, B.; Schenck, A. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). Feb 1988. NTIS, PC A05/MF A01. (NASA-CR—182891; NAS—1.26:182891).

In Materials science with muon spin rotation. Annual report, 1 March 1987-29 February 1988.

Zero- and longitudinal-field muon spin relaxation measurements on a heavy fermion system CeCu2.1 Si2 have revealed an onset of static magnetic ordering below T(M) approximately 0.8 K, which coexists with superconductivity below T(c) = 0.7 K. The line shapes of the observed muon spin depolarization functions sug-

gest an ordering in either spin glass or incommensurate spin-density-wave state, with a small averaged static moment of the order of 0.1 micro-B per formula unit at T approaches 0.

1079 **(N—88-24242) Comparison between muon spin rotation and neutron scattering studies on the 3-dimensional magnetic ordering of $La_2CuO(4-y)$.** Uemura, Y.J.; Kossler, W.J.; Kempton, J.R.; Yu, X.H.; Schone, H.E.; Opie, D.; Stronach, C.E.; Brewer, J.H.; Kiefl, R.F.; Kreitzman, S.R. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. 10p. (NASA-CR—182891; NAS—1.26:182891; CONF-880206—). NTIS, PC A05/MF A01.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

Muon spin rotation and neutron scattering studies on powder and single-crystal specimens of $La_2CuO(4-y)$ are compared. The apparent difference between the muon and neutron results for the ordered moment in the antiferromagnetic state is interpreted as the signature of increasingly short-ranged spatial spin correlations with increasing oxygen content.

1080 **(N—88-24242) Static magnetic ordering of CeCu/sub 2.1/Si_2 found by muon spin relaxation.** Uemura, Y.J.; Kossler, W.J.; Yu, X.H.; Schone, H.E.; Kempton, J.R.; Stronach, C.E.; Barth, S.; Gygax, F.N.; Hitti, B.; Schenck, A. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. vp. (NASA-CR—182891; NAS—1.26:182891; CONF-880206—). NTIS, PC A05/MF A01.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

Zero- and longitudinal-field muon spin relaxation measurements on a polycrystal sample of a heavy fermion superconductor CeCu/sub 2.1/Si_2 (T(c) = 0.7 K) have revealed an onset of static magnetic ordering below T approximately 0.8 K. The line shapes of the observed spectra in zero field indicate a wide distribution of static random local fields at muon sites, suggesting that the ordering is either spin glass or incommensurate spin-density-wave state. The observed width of the random local field at T = 0.05 K corresponds to a small averaged static moment of the order of 0.1 micro-B per formula unit.

1081 **(N—88-24712) 700 F properties of autoclave cured PMR-2 composites.** Vannucci, R.D.; Cifani, D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 17p. (NASA-TM—100923; E—4186; NAS—1.15:100923; CONF-880909—). NTIS, PC A03/MF A01.

From 20. international conference of the Society for the Advancement of Materials and Process Engineering; Minneapolis, MN, USA (27 Sep 1988).

Studies were conducted to develop autoclave processing parameters for graphite reinforced PMR-2 resin composite materials intended for use in applications at temperatures up to 371 degrees (700 F). The effect of resin composition on autoclaveability was investigated. The effect of various graphite fibers and resin composition on 343 C (650 F) and 371 C (700 F) thermo-oxidative stability and mechanical properties was also investigated. The results of the processing studies show that PMR-2 resin composites can be easily fabricated under autoclave conditions. Autoclaved laminates exposed to 1 atm of air at 343 C (650 F) and 371 C (700 F) exhibited less than 5 percent weight loss after 750 hr exposure to 650 F air and 8 percent weight loss during exposure to 700 F air for 500 hr. After 500 hr exposure, autoclaved laminates exhibited greater than 90 percent retention of initial 650 and 700 F flexural and interlaminar shear strengths. The effect of resin formulated molecular weight and postcure conditions on laminate glass transition temperature is also discussed.

1082 **(N—88-24713) Analysis of notched metal matrix composites under tension loading.** Bigelow, C.A. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jun 1988. 44p. (NASA-TM—100629; NAS—1.15:100629). NTIS, PC A03/MF A01.

Presented are techniques based on 3-D finite-element analysis for the examination of continuous fiber reinforced metal matrix composites. Examples are shown for specific metal matrix composites such as boron/aluminum and silicon carbide/aluminum. Specimen stress-strain behavior and stress at first fiber failure were predicted for boron/aluminum laminates containing circular holes and crack-like slits. The predictions compared very well for (+ or - 45) sub 2s laminates. Mesh configuration was shown to have an effect on the calculation of stresses local to the notch. The presence of thin interface layers of matrix material had a significant influence on the slit-tip stress state, causing sharper stress gradients near the notch. Interface layers reduced the slit-tip fibers stresses in a (+ or - 45) sub s silicon-carbide/aluminum laminate but increased them in a (0/90) sub s laminate.

1083 **(N—88-25483) Thermally modified polymer matrix composite material with structural integrity to 371 C.** Bowles, K.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 12p. (NASA-TM—100922; E—4182; NAS—1.15:100922; CONF-880909—). NTIS, PC A03/MF A01.

From 20. international conference of the Society for the Advancement of Materials and Process Engineering; Minneapolis, MN, USA (27 Sep 1988).

The potential for utilizing surface coatings to inhibit the thermal oxidation of polymer matrix composites was studied. Isothermal, inert gas exposures of graphite/PMR-15 composites indicated that after an initial loss of weight, no significant amounts of thermal degradation products are given off during high temperature exposures in the absence of oxygen. As long as a coating remains effective, the composite material should remain stable. It was also found that the glass transition temperature T sub g of the matrix resin could be increased to values in excess of 400 C. This resulted in measured short beam shear strengths of 75.9 MPa (11 Ksi), flexural strengths of 1172 MPa (170 Ksi) and flexural moduli of 141 GPa (20.5 Msi) for the material at a test temperature of 371 C. The treatment that was used caused a decrease in the PMR-15 resin density from 1.31 to 1.29 gm/cc. It was concluded that state-of-the-art composites, protected by oxygen-impervious coatings, can be used as materials of construction with structural integrity to at least 371 C and possibly above.

1084 **(N—88-25484) Temperature-dependent tensile and shear response of graphite/aluminum.** Fujita, T.; Pindera, M.J.; Herakovich, C.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). May 1987. 139p. (NASA-CR—182914; NAS—1.26:182914; PB—88-181037; VPI-E—87-8; CCMS—87/08). NTIS, PC A07/MF A01.

The thermo-mechanical response of unidirectional P100 graphite fiber/6061 aluminum matrix composites was investigated at four temperatures:-150, +75, +250, and +500 F. Two types of tests, off-axis tension and losipescu shear, were used to obtain the desired properties. Good experimental-theoretical correlation was obtained for Exx, vxy, and G12. It is shown that E11 is temperature independent, but E22, v12, and G12 generally decrease with increasing temperature. Compared with rather high longitudinal strength, very low transverse strength was obtained for the graphite/aluminum. The poor transverse strength is believed to be due to the low interfacial bond strength in this material. The strength decrease significantly with increasing temperature. The tensile response at various temperatures is greatly affected by the residual stresses caused by the mismatch in the coefficients of thermal expansion of fibers and matrix. The degradation of the aluminum matrix properties at higher temperatures has a deleterious effect on composite properties. The composite has a very low coefficient of thermal expansion in the fiber direction.

1085 **(N—88-25487) Auger analysis of a fiber/matrix interface in a ceramic matrix composite.** Honecy, F.S.; Pepper, S.V. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 10p. (NASA-TM—100892; E—4130; NAS—1.15:100892; CONF-880408—). NTIS, PC A02/MF A01.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Auger electron spectroscopy (AES) depth profiling was used to characterize the fiber/matrix interface of an SiC fiber, reaction bonded Si_3N_4 matrix composite. Depth profiles of the as re-

ceived double coated fiber revealed concentration oscillations which disappeared after annealing the fiber in the environment used to fabricate the composite. After the composite was fractured, the Auger depth profiles showed that failure occurred in neither the Beta-SiC fiber body nor in the Si_3N_4 matrix but, concurrently, at the fiber coating/matrix interface and within the fiber coating itself.

1086 (N—88-26482) Fracture resistance of a TiB_2 particle/SiC matrix composite at elevated temperature. Jenkins, M.G.; Salem, J.A.; Seshadri, S.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1988. 18p. (NASA-TM—100967; E—3842-1; NAS—1.15:100967). NTIS, PC A03/MF A01.

The fracture resistance of a comercial TiB_2 particle/SiC matrix composite was evaluated at temperatures ranging from 20 to 1400 C. A laser interferometric strain gauge (LISG) was used to continuously monitor the crack mouth opening displacement (CMOD) of the chevron-notched and straight-notched, three-point bend specimens used. Crack growth resistance curves (R-curves) were determined from the load versus displacement curves and displacement calibrations. Fracture toughness, work-of-fracture, and R-curve levels were found to decrease with increasing temperature. Microstructure, fracture surface, and oxidation coat were examined to explain the fracture behavior.

1087 (ORNL/Sub—84-47989/3) Absorption fluids data survey: Final report on worldwide data. Macriss, R.A.; Gutraj, J.M.; Zawacki, T.S. (Oak Ridge National Lab., TN (USA); Institute of Gas Technology, Chicago, IL (USA)). Feb 1988. Contract AC05-84OR21400. 280p. NTIS, PC A13/MF A01. Order Number DE89001580/JAW.

Over 500 different worldwide publications containing data that relate to properties of binary, ternary, and multicomponent absorption fluids have been identified; from these publications, 278 were selected as primary sources of relevant data. Fluids covered include combinations of 38 different refrigerant compounds, as well as of 131 single, 42 binary, and 14 ternary absorbent compounds. Generally, the 38 refrigerants are divided among the following categories of chemical compounds: inorganic, 3; organic, 35 (amines, 4; alcohols, 5; halogenated, 25; and hydrocarbons, 1). The single absorbent compounds generally are subdivided as follows: inorganic, 48; organic, 83 (alcohols, 10; ethers, 5; alcohol-ethers, 3; amides, 9; amines, 4; amine-alcohols, 1; esters, 21; ketones, 5; acids, 4; aldehydes, 1; and others, 20). The binary and ternary absorbents are various mixtures of two or more single absorbent compounds. Coarse screening and evaluations were performed. Data gaps for key fluids are summarized and unresolved conflicts in data are noted. Results show that, with very few exceptions, all candidate fluids for development activities dealing with advanced absorption heat pump concepts have data gaps that must be addressed in the near future. 44 figs., 6 tabs.

1088 (PB—88-237029/XAB) Consideration of ionizing radiation shielding for optical fibers. Englert, T.J. (Wyoming Univ., Laramie (USA). Dept. of Electrical Engineering). Jun 1988. 37p. NTIS, PC A03/MF A01.

A brief overview of nuclear radiation processes is presented. Units of radiation energy and dose are discussed. Interactions of radiation processes with matter are analyzed in order to understand radiation and its energy. Range is discussed in relation to structures of matter in representative materials. Specific emphasis is placed on interaction of these radiation processes with soils in order to consider the ultimate effects of radiation on optical fibers located in a medium of soil and soil types. The shielding effects of soils are analyzed for the purpose of understanding radiation damage to any buried cable that may contain optical fibers.

1089 (SAND—88-0461C) Safety considerations for high-efficiency crystalline-silicon solar cell fabrication. Ruby, D.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880965—13). NTIS, PC A02/MF A01. Order Number DE89001362/JAW.

From 20. IEEE photovoltaic specialists conference; Las Vegas, NV, USA (26 Sep 1988).

The fabrication of high-efficiency crystalline-silicon solar cells involves the use of hazardous chemicals which must be handled carefully and disposed of properly. This can be done in a facility that has been designed to minimize the probability of having an accident and which mitigates the damage of those that do occur. An analysis of such safety features is presented here for a facility designed to fabricate crystalline-silicon solar cells of the types shown to exhibit record-high efficiencies, both under concentrated and one-sun illumination. For comparison, the analogous safety measures that need to be taken in a thin-film solar cell production facility are also noted. This contrast reveals the inherently safer nature of crystalline-silicon solar cell processing, and consequently, its lower safety-related costs. 19 refs., 1 fig.

1090 (SAND—88-1295) Simultaneous measurement of the conduction and valence-band masses in strained-layer structures. Jones, E.D.; Lyo, S.K.; Klem, J.F.; Schirber, J.E.; Tigges, C.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-8809152—1). NTIS, PC A02/MF A01. Order Number DE88017349/JAW.

From International symposium on gallium-arsenide and related compounds; Atlanta, GA, USA (11 Sep 1988).

Simultaneous measurement of both the conduction and valence-band masses in strained-layer structures is presented. These measurements rely on application of our recent theoretical predictions regarding breaking of the usual selection rules for interband magneto-luminescence transitions in modulation-doped structures. Thus, from a single sample, the dispersion relations for both the conduction and valence-band can be measured and analyzed. Low-temperature (4K) magneto-luminescence data for a representative GaAs/InGaAs/AlGaAs (15% In, Al) n-type 125{angstrom} single-strained-quantum well structure are presented. We measure zone-center conduction and valence-band effective masses of $0.068m_0$ and $0.10m_0$, respectively. For increasing band energies (40 MeV above the bandgap energy) the conduction-band is parabolic while the valence-band is highly nonparabolic; the valence-band mass increased to about $0.2m_0$ in this energy range. 12 refs., 4 figs.

1091 (SAND—88-1437C) Hall-effect and photoluminescence microscopy studies of dislocation formation in strained-layer epitaxy of InGaAs/GaAs. Fritz, I.J.; Gourley, P.L.; Dawson, L.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-8809152—3). NTIS, PC A02/MF A01. Order Number DE89001373/JAW.

From International symposium on gallium-arsenide and related compounds; Atlanta, GA, USA ('1 Sep 1988).

Hall-mobility measurements in modulation-doped strained quantum-well structures are highly sensitive to dislocations, and mobility studies have determined critical layer thicknesses for strained-layer epitaxy in InGaAs/GaAs structures. Recent measurements on quasi-pseudomorphic multiple strained quantum-well structures have shown good electrical properties for structures with nominal strain energy up to {approximately}30 times the value expected for dislocation formation. This result has been achieved in 30-period structures with widely spaced ({approximately}50nm) layers of In/sub 0.2/Ga/sub 0.8/As, each somewhat thinner than the critical layer thickness of {approximately}15nm. Photoluminescence microscopy studies on these structures show dislocations only near the deepest interfaces, suggesting that most of the quantum wells are of high quality. 9 refs., 9 figs.

1092 (SAND—88-2494C) Summary of aging effects on 25-year old nylon parachutes. Tadios, E.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-8804204—1). NTIS, PC A02/MF A01. Order Number DE89001378/JAW.

From 10. AIAA aerodynamic decelerator systems technology conference; Cocoa Beach, FL, USA (18 Apr 1988).

Structural evaluations were conducted on several parachute systems to determine the effects of aging on parachute materials. Most of the parachutes were 25 years old. Five 64 ft parachutes were evaluated along with one 4 ft guide surface parachute and three 16.5 ft ribbon parachutes. The parachute systems used in the study were all fabricated from nylon materials. Results were obtained for several material properties such as tensile strength, air permeability and melting point. Military specifications were used as

zero-time data base due to lack of raw material data. The results indicate that over a period of about 25 years, parachute nylon materials do not degrade to unacceptable levels. 7 refs., 2 figs., 3 tabs.

1093 **(SAND—88-2588C) Characteristics of lift-off fabricated AlGaAs/InGaAs single-strained-quantum-well structures on glass and silicon substrates.** Klem, J.F.; Jones, E.D.; Myers, D.R.; Lott, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-8809152—4). NTIS, PC A02/MF A01. Order Number DE89001374/JAW.

From International symposium on gallium-arsenide and related compounds; Atlanta, GA, USA (11 Sep 1988).

A technique involving the liftoff of thin ({approx}1 {mu}m) III-V structures grown on GaAs substrates and subsequent bonding to glass or SiO{sub 2}-covered Si substrates has been investigated. AlGaAs/InGaAs/GaAs single-strained-quantum-well structures have been grown by molecular beam epitaxy and characterized before and after lift-off and bonding to foreign substrates. X-ray diffraction measurements were performed to determine the strain state of the films over a wide temperature range after bonding. Low-temperature photoluminescence measurements on 125{angstrom}-well undoped structures show that the narrow linewidths observed in the as-grown samples ({approx}4 MeV) are not broadened by the lift-off and bonding process. Room- and low-temperature dc measurements made on modulation-doped field-effect transistors show that electronic transport properties are not adversely affected by this process. 8 refs., 6 figs.

1094 **(SAND—88-2686) Parachute drawing standards currently in use at Sandia National Laboratories.** Ronquillo, K.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-8804204—2). NTIS, PC A03/MF A01. Order Number DE89001365/JAW.

From 10. AIAA aerodynamic decelerator systems technology conference; Cocoa Beach, FL, USA (18 Apr 1988).

A need exists in the parachute industry for a standard method of defining and guiding the formation of textile drawings. Textile drawings have their own unique problems associated with their development. Unlike mechanical parts, textiles have no mass in cross section. Therefore, a cross-sectioned view has no hash marks. Hidden views are not usually incorporated in textile drawings as they are easily confused with stitch formations. Side views of textile parts are depicted using only one line to show thickness. This report will address these and other unique drawing problems associated with the development of parachute drawings and will offer, as a base, standards to be used when developing these drawings. 21 figs.

1095 **(UCID—21494) UHV bonding.** King, W.E. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01. Order Number DE89001837/JAW.

The lack of well characterized, precisely oriented interfaces has been identified as limiting the capability of the Interface Science community to make progress in the study of structure and properties of interfaces. This point was underlined at the DOE workshop on Interfaces and Grain boundaries and interfaces held in January 1988 in Santa Barbara. Lawrence Livermore National Laboratory (LLNL) and Sandia National Laboratories (SNL) are developing a multi-disciplinary, multi-institutional research effort in interface science. This research, which will focus on the influence of impurities, flaws, and inclusions on adhesion and bonding at internal interfaces will rely on the availability of bicrystals with well defined interfacial chemistry and highly reproducible misorientations. The capability to produce such bicrystals currently does not exist within the United States although it is critical to further advancement of interface science and technology. 13 figs., 2 tabs.

1096 **(UCID—21504) Facilities, testing, and continuing studies on carbon-black loaded styrene-butadiene rubber.** Goldberg, A.; Sanchez, R.J.; LeMay, J.D.; Patt, J. (Lawrence Livermore National Lab., CA (USA)). 15 Sep 1988. Contract W-7405-ENG-48. 52p. NTIS, PC A04/MF A01. Order Number DE89001858/JAW.

The Lawrence Livermore National Laboratory (LLNL) has been involved with investigations dealing with the response of the rubber in tank track pads to various loading scenarios, both in the field and in the laboratory. In the laboratory, numerous studies were also performed on a number of other rubber formulations primarily involving a range of carbon-black loadings in SBR and NR. Reference is made to reports and papers addressing each of the studies involved in this program. Work performed during the final stages of this program is described. These studies were directed primarily at developing an understanding of the effects of cycling and notching histories, notch radius, notch depth, and specimen thickness on the deformation behavior, strain distributions, hysteresis, and residual strength of SBR containing various amounts of carbon black. Significant improvements were realized in our testing methodology, computer-controlled facilities, and data-acquisition system, and in our ability to obtain continuous photomicrographic documentation in "real time" of the tearing improvements, as they relate to the various studies, are detailed in this document. Results obtained in these studied involve (1) the fabrication and testing of thick tensile specimens, (2) the effect of notching under load on the residual strength, (3) the effect of cycling on residual strength of notched and notch-free specimens, (4) the effect of cycling on hysteresis, (5) the effect of notch radius for various notch depths on loss of strength, and (6) evaluation of strain at a notch tip and remote from the notch tip at various specimen extensions by analyzing the specimen grid markings, which were obtained with the microscope-video-Polaroid system. 15 refs., 27 figs.

1097 **(UCRL—95284) Variations with laser pulse duration of the thresholds at 350-nm and 1064-nm for bulk damage in crystals of KDP [potassium dihydrogen phosphate].** Gonzales, R.P.; Staggs, M.C.; Singleton, M.F.; George, D.; Weinzapfel, C.L.; Weinzapfel, S. (Lawrence Livermore National Lab., CA (USA)). 7 Sep 1988. Contract W-7405-ENG-48. 19p. (CONF-8611154—4). NTIS, PC A03/MF A01. Order Number DE89001355/JAW.

From Boulder damage symposium; Boulder, CO, USA (3 Nov 1986).

Five separate laser facilities were used to measure 350-nm and 1064-nm thresholds for bulk damage in crystals of potassium dihydrogen phosphate (KDP). At 1064 nm, tests were made with single laser pulses having durations from 1 to 20 ns and with 9-ns incident at 10 Hz. At 350 nm tests were made with single pulses having durations of 0.6, 5 and 25 ns and with 25-ns pulses incident at rates up to 50 Hz. Over the range from 0.6 to 25 ns, 350-nm thresholds increased by factors of approximately 2 to 3, and 350-nm thresholds were almost independent of laser repetition rate. The 1064-nm thresholds increased by a factor of 2 as pulse duration increased from 1 to 20 ns. Laser hardening of thresholds at 1064-nm was observed after hardening at both 350 nm and 1064 nm.

1098 **(UCRL—98594) Microstructural characterization of low-density foams.** Price, C.W. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 19p. (CONF-8807110—1). NTIS, PC A03/MF A01. Order Number DE88016171/JAW.

From Fine Particle Society meeting; Santa Clara, CA, USA (19 Jul 1988).

Low-density foams (of the order 0.1 g/cm^3) synthesized from silica aerogel, resorcinol/formaldehyde, and cellulose acetate have fine, delicate microstructures that are extremely difficult to characterize. Improved low-voltage resolution of an SEM equipped with a field-emission gun (FESEM) does permit these materials to be examined directly without coating and at sufficient magnification to reveal the microstructures. Light coatings applied by ion-beam deposition can stabilize the specimens to some extent and reduce electron charging without seriously altering the microstructure, but coatings applied by conventional techniques usually obliterate these microstructures. Transmission electron microscopy (TEM) is required to provide unambiguous microstructural interpretations. However, TEM examinations of these materials can be severely restricted by specimen preparation difficulties and electron-beam damage, and considerable care must be taken to ensure that reasonably accurate TEM results have been obtained. This work demonstrates that low-voltage FESEM analyses can be used to characterize microstructures in these foams, but TEM analyses are required

to confirm the FESEM analyses and perform quantitative measurements. 19 refs., 11 figs.

1099 **(UCRL—99629) Modeling induction heating and 3-D heat transfer for growth of rectangular crystals using FIDAP.** Atherton, L.J.; Martin, R.W. (Lawrence Livermore National Lab., CA (USA)). 19 Sep 1988. Contract W-7405-ENG-48. 37p. (CONF-8810186—1). NTIS, PC A03. Order Number DE89001323/JAW.

From FIDAP users conference; Evanston, IL, USA (2 Oct 1988).

We are developing a process to grow large rectangular crystals for use as solid state lasers by a Bridgman-like method. The process is based on induction heating of two graphite susceptors which transfer energy to an ampoule containing the melt and crystal. The induction heating version of FIDAP developed by Gresho and Derby is applied to this system to determine the power deposition profile in electrically conducting regions. The calculated power is subsequently used as a source term in the heat equation to calculate the temperature profile. Results are presented which examine the sensitivity of the system to electrical and thermal conductivities, and design modifications are illustrated which could improve the temperature field for crystal growth applications. 6 refs., 29 figs., 2 tabs.

1100 **Quantum chemical study of adhesion at the SiC/Al interface.** Li, S.; Arsenault, R.J.; Jena, P. (Engineering Materials Group, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* **64**: No. 11, 6246-6253(1 Dec 1988).

Using the intermediate neglect of differential overlap approximation, the total energies of a number of clusters modelled to represent the SiC/Al interface have been calculated as a function of distance separating the two surfaces of SiC and Al. The adhesive energy of the interface is calculated by minimizing the total energies corresponding to various crystallographic orientations of the SiC and Al surfaces. The results are used to provide semiquantitative understanding of the bonding mechanism and the effect of reconstruction at the SiC/Al interface.

1101 **Stability of TaSi/sub x/-GaAs Schottky barriers in rapid thermal processing.** Haynes, T.E.; Chu, W.K.; Han, C.C.; Lau, S.S.; Picraux, S.T. (University of North Carolina, Chapel Hill, North Carolina 27599-3255). *Applied Physics Letters;* **53**: No. 22, 2200-2202(28 Nov 1988).

n-type GaAs samples coated with $TaSi_2$ and Ta_5Si_3 Schottky barrier contacts were heated in a flashlamp rapid thermal processing (RTP) system to temperatures between 600 and 950 °C. We have measured the evaporation of gallium and arsenic through the contact overlayers which results from the decomposition of the GaAs substrate. These decomposition measurements have been correlated with the Schottky barrier behavior as determined from forward-bias current-voltage characteristics and selected capacitance-voltage measurements. The high-temperature stability against decomposition and electrical degradation was superior for Ta_5Si_3 contacts relative to $TaSi_2$ contacts. We observed for both contact compositions that the onset temperature for decomposition of GaAs was slightly lower than the maximum temperature for electrical stability. Thus, we found that in some cases substantial decomposition occurred with no effect on the current-voltage characteristics. For example, Ta_5Si_3 contacts maintained a stable barrier height of 0.78 eV through 10 s RTP treatments up to 900 °C, in spite of decomposition of at least ten equivalent monolayers of GaAs.

1102 **Sound velocity and index of refraction of AlAs measured by picosecond ultrasonics.** Grahn, H.T.; Young, D.A.; Maris, H.J.; Tauc, J.; Hong, J.M.; Smith T.P. III. (Department of Physics and Division of Engineering, Brown University, Providence, Rhode Island 02912). *Applied Physics Letters;* **53**: No. 21, 2023-2024(21 Nov 1988).

We use picosecond optics techniques to generate and detect acoustic pulses in an epitaxially grown film of AlAs. From the round trip time of the acoustic pulse we find a sound velocity in the [100] direction of 6.4×10^5 cm s^{-1}. We also show how measurements of this type can be used to determine the refractive index.

1103 **(111) oriented (GaAs)/sub n/(AlAs)/sub n/ superlattices are direct band-gap materials for all n's.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Applied Physics Letters;* **53**: No. 21, 2077-2079(21 Nov 1988).

Total energy calculations show that the (111) (AlAs)/sub n/(GaAs)/sub n/ superlattice has a lower formation enthalpy (i.e., is stabler) than either the (001) or (110) superlattices. Self-consistent band structure calculations further show that while the (001) superlattice is direct only for $n>7$, the (111) superlattice has (i) a smaller and (ii) a direct (not pseudodirect) gap for all n's. Contrary to the expectations based on particle in a box models, the confined states at the zone center are strongly localized even for the monolayer superlattice.

1104 **Asymmetries in dislocation densities, surface morphology, and strain of GaInAs/GaAs single heterolayers.** Kavanagh, K.L.; Capano, M.A.; Hobbs, L.W.; Barbour, J.C.; Maree, P.M.J.; Schaff, W.; Mayer, J.W.; Pettit, D.; Woodall, J.M.; Stroscio, J.A.; and others. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Applied Physics;* **64**: No. 10, 4843-4852(15 Nov 1988).

The dislocation densities, surface morphology, and strain of Ga/sub 1-//sub x/In/sub x/As/GaAs epitaxial interfaces as a function of indium composition and layer thickness have been investigated by transmission electron microscopy, medium energy ion blocking, and double-crystal x-ray diffractometry. The electron microscopy shows that in the thinnest dislocated films (90 and 160 nm, $x = 0.07$) 60° α dislocations form first in one <110> direction at the interface. Surprisingly, however, an asymmetry in residual layer strain is not detected in these samples, suggesting that the dislocations have the same Burgers vector or are evenly distributed between two Burgers vectors. Orthogonal arrays of dislocations are observed in films thicker than 300 nm (60° and edge-type, $x = 0.07$). In this case, dislocation densities in each <110> direction are equal to within experimental error while an asymmetry in in-plane strain is measured (18% and 30% for $x = 0.07$, 300, and 580 nm thick, respectively). An unequal distribution of Burgers vectors of 60° or edge-type dislocations is considered responsible for the strain asymmetry in these thicker samples.

1105 **Composition-structure relationships for multisource evaporated $CuGaSe_2$ thin films.** Albin, D.; Noufi, R.; Tuttle, J.; Goral, J.; Risbud, S.H. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* **64**: No. 10, 4903-4908(15 Nov 1988).

X-ray diffraction (XRD) analysis of doublet formation and peak shifts were used to observe the compositional dependence of the order—disorder transition in polycrystalline $CuGaSe_2$ thin films deposited by multisource evaporation. Cu-poor material had a strong tendency to disorder as evidenced by the simultaneous presence of both the chalcopyrite and sphalerite phases. Stoichiometric and Cu-rich material contained only the tetragonal phase as observed by XRD. Comparison of Cu-poor XRD patterns with theoretical calculations reflecting probable defect chemistries (V/sub Cu/, Ga/sub Cu/, V/sub Se/) suggests an interesting microstructure. The absence of higher index group (iii) reflections, notably the (103) and (211) peaks, in chalcopyrite material suggest that the tetragonal phase maintains a near-stoichiometric composition. Overall Cu-poor film compositions may therefore be obtained by adjustment within the cubic phase which implies compositional segregation between the phases.

1106 **Kinetics of H_2 passivation of P/sub b/ centers at the (111) Si-SiO_2 interface.** Brower, K.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9657-9666(15 Nov 1988).

This paper is concerned with the determination of the kinetic parameters and the chemical reactions that characterize the passivation of P/sub b/ centers with molecular hydrogen. P/sub b/ centers are paramagnetic defects at the (111) Si-SiO_2 interface. In this study P/sub b/ centers associated with thermal oxides grown on (111) silicon substrates at 850 °C were measured with electron paramagnetic resonance. We observe that the P/sub b/ resonance ap-

pears to be unaffected by subsequent in situ vacuum anneals for temperatures up to at least 850 °C.

1107 **Absorption saturation of heavy- to light-hole band transitions in p-type InSb.** James, R.B.; Chang, Y. (Theoretical Division, Sandia National Laboratories, P.O. Box 969, Livermore, California 94550). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9778-9789(15 Nov 1988).

We present calculations of the intensity dependence of the free-hole absorption coefficient in p-type indium antimonide for high-intensity light with a wavelength near 10 μm. The dominant absorption mechanism is direct inter-valence-band transitions, where a hole occupying a state in the heavy-hole band makes a direct transition to a state in the light-hole band. The absorption coefficient due to this mechanism is predicted to decrease with increasing intensity in a manner closely approximated by an inhomogeneously broadened two-level model. Values for the saturation intensity I/sub S/ are reported as a function of the photon energy, lattice temperature, and hole density. The dependence of I/sub S/ on the hole concentration allows considerable tunability of the saturation behavior, so that for a fixed laser intensity, the degree of absorption saturation can be adjusted by controlling the doping density of the sample. For lightly doped samples at a temperature of 77 K, the free-hole absorption begins to saturate at intensities of less than 10 kW/cm², which is between one and two orders of magnitude smaller than the intensities required to saturate the comparable transitions in Ge and GaAs. The calculated results are also important to measurements of the two-photon absorption coefficient K_2 in InSb, and they indicate that much of the transmission data used to obtain a value for K_2 must be reevaluated.

1108 **High-pressure studies of GaAs-Al/sub x/Ga/sub 1-//sub x/As quantum wells at 300 and 80 K using photoreflectance spectroscopy.** Kangarlu, A.; Chandrasekhar, H.R.; Chandrasekhar, M.; Kapoor, Y.M.; Chambers, F.A.; Vojak, B.A.; Meese, J.M. (Department of Physics and Astronomy, University of Missouri—Columbia, Columbia, Missouri 65211). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9790-9796(15 Nov 1988).

A detailed photoreflectance study of a GaAs-Al/sub 0.3/Ga/sub 0.7/As multiple quantum well of well width 260 A is carried out at 300 and 80 K. The pressure dependence of a large number of quantized states is observed. The sublinearity of pressure dependence increases with increasing quantum number. A model calculation that includes the pressure dependence of electron effective mass accurately describes the data. Transitions associated with L and X band extrema are observed and their pressure coefficients deduced.

1109 **Thermal emission of holes from defects in uniaxially stressed p-type silicon.** Nolte, D.D.; Haller, E.E. (Center for Advanced Materials, Lawrence Berkeley Laboratory, University of California at Berkeley, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9857-9869(15 Nov 1988).

Iron-acceptor pair defects in silicon are insensitive to stress. These defects therefore provide convenient reference points from which to measure the effects of uniaxial stress on the valence-band structure in silicon. Despite the strong mixing of light- and heavy-hole bands at low values of stress, we find that for thermal emission the stress-split valence band can be approximated as two independent bands that displace rigidly with increasing stress according to the shear deformation potentials. The spherical approximation for the effective masses is not consistent with these deformation potentials because the approximation incorrectly partitions the density of states between the two bands. We establish the correct partitioning of the density of states numerically, and find stress-dependent density of states that approximately conserve the center of gravity of the split valence bands. Uniaxial stress data on the Fe-Al defects in silicon are used to experimentally verify the numerical results. The analysis described in this paper can be easily generalized to determine the stress properties of hole traps in any p-type semiconductor.

1110 **Determination of the bonding and growth of Ag on Si(100)-(2 x 1).** Samsavar, A.; Miller, T.; Chiang, T. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9889-9894(15 Nov 1988).

The bonding and growth of Ag on Si(100) were studied with high-resolution photoemission spectroscopy and high-energy electron diffraction. By monitoring the changes in the Si 2p core-level and Ag 4d valence-band line shapes, we have examined the chemical interaction between the Ag adatoms and Si surface dimer atoms. The Ag-to-Si bonding coordination number as a function of coverage was obtained. This number is 2 at low Ag coverages, which suggests that the bonding site for a Ag adatom is between two neighboring Si surface dimers along the direction of dimerization; the two dimer dangling bonds pointing at the Ag adatom join the two Ag sp hybrid orbitals to form two Ag-Si bonds. The growth mode was observed to be three dimensional at higher coverages. The Schottky-barrier height was measured.

1111 **Simulation of the V/sub k/ center in LiF using Hartree-Fock clusters.** Pandey, R.; Kunz, A.B. (Department of Physics, Michigan Technological University, Houghton, Michigan 49931). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 10150-10153(15 Nov 1988).

The role of accurate solid-state modeling to describe charged defects in ionic crystals is assessed in several well-defined models using a well-characterized point defect: the V/sub k/ center. This defect is considered as a F_2^- molecular ion in LiF and is simulated using Hartree-Fock molecular clusters consisting of the defect and/or its nearest-neighbor Li^+ ions. We find that the stabilization energy of the defect is almost entirely controlled by the presence of the distorted lattice whereas the internuclear separation in the defect appears to be affected by the crystalline environment. The hyperfine constants for the defect and the neighboring nuclei are calculated and compared with experiment.

1112 **Band lineup in GaAs/sub 1-//sub x/Sb/sub x//GaAs strained-layer multiple quantum wells grown by molecular-beam epitaxy.** Ji, G.; Agarwala, S.; Huang, D.; Chyi, J.; Morkoc, H. (Coordinated Science Laboratory, University of Illinois at Urbana-Champaign, 1101 West Springfield Avenue, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* **38**: No. 15, 10571-10577(15 Nov 1988).

GaAs/sub 1-//sub x/Sb/sub x//GaAs strained-layer multiple quantum wells have been grown by molecular-beam epitaxy and characterized by room-temperature photoreflectance (PR). The PR spectra denote that high-quality layers can be grown in the GaAs/sub 1-//sub x/Sb/sub x//GaAs system. The method for determining the band offset Q/sub v//sub h/ is discussed in this strained-layer system. Based on this treatment and the band-gap formula of bulk GaAs/sub 1-//sub x/Sb/sub x/ a value of the heavy-hole band offset (Q/sub v//sub h/ ~ 1.7) has been obtained for GaAs/sub 1-//sub x/Sb/sub x//GaAs with $x = 0.1$ establishing a type-II structure with electrons in GaAs layers and heavy and light holes in GaAs/sub 1-//sub x/Sb/sub x/ layers, respectively.

1113 **Local charge-density-wave structure in 1T-TaS_2 determined by scanning tunneling microscopy.** Thomson, R.E.; Walter, U.; Ganz, E.; Clarke, J.; Zettl, A.; Rauch, P.; DiSalvo, F.J. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **38**: No. 15, 10734-10743(15 Nov 1988).

We have imaged simultaneously the lattice and the charge-density-wave (CDW) superstructure in 1T-TaS_2 over the temperature range 370—77 K. In the nearly commensurate (NC) phase between 353 and 183 K we find that the CDW occurs not in commensurate domains but with a uniform, incommensurate orientation throughout the crystal surface. Local measurements of the relative angle between the CDW and the underlying atomic lattice failed to find any areas where the local angle was the commensurate angle, in contradiction to the hexagonal-domain NC-phase model of Nakanishi and Shiba. In the nearly commensurate triclinic (T) phase between 223 and 283 K produced when the temperature is in-

creased, we have directly observed CDW discommensurations in agreement with the stretched honeycomb discommensurate T-phase model of Nakanishi and Shiba.

1114 **Electronic structure, hyperfine interactions, and magnetic properties for iron octahedral sulfides.** Braga, M.; Lie, S.K.; Taft, C.A.; Lester W.A. Jr. (Departamento de Quimica Fundamental, Universidade Federal de Pernambuco, 50chemical bond739 Recife, Pernambuco, Brazil). *Physical Review [Section] B: Condensed Matter;* **38**: No. 15, 10837-10851(15 Nov 1988).

Spin-polarized multiple-scattering calculations have been performed for FeS_6/sup n-/ (n = 8,9,10) clusters in order to study the electronic structure of the iron atom octahedrally coordinated to sulfur. The calculated total spin and charge densities in connection with the 3d and 4s atomic population are used to interpret the Moessbauer hyperfine parameters. A detailed discussion of the hyperfine interaction and magnetic properties is given for the spinel greigite (Fe_3S_4). Possible existence of an Fe(IV) state is discussed.

1115 **Electronic structure and optical properties of the impurity Cu^+ in NaF.** Meng, J.; Kunz, A.B.; Woodward, C. (Department of Physics, Michigan Technological University, Houghton, Michigan 49931). *Physical Review [Section] B: Condensed Matter;* **38**: No. 15, 10870-10873(15 Nov 1988).

The electronic structure of the impurity Cu^+ in a sodium fluoride crystal has been studied using the ICECAP (ionic crystal with electronic cluster, automatic program) methodology, which treats the defect and its vicinity quantum mechanically as a molecular cluster embedded in a shell-model lattice. The electrons in the cluster have been treated in the unrestricted Hartree-Fock self-consistent-field approximation, corrected for correlation by use of the many-body perturbation theory. The surrounding infinite lattice has been described by the shell model that incorporates host polarization and distortion self-consistently. The basis sets used to describe the Cu^+ ion were optimized. The excitation energy and the crystal-field splitting were computed as 4.02 and 0.31 eV, respectively, versus the corresponding experimental results of 4.20 and 0.35 eV, respectively.

1116 **High photoconductive gain in lateral InAsSb strained-layer superlattice infrared detectors.** Kurtz, S.R.; Biefeld, R.M.; Dawson, L.R.; Fritz, I.J.; Zipperian, T.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **53**: No. 20, 1961-1963(14 Nov 1988).

Both large photoconductive gain and long wavelength photoresponse were observed in lateral photodetectors constructed from type II, InAsSb, strained-layer superlattices. In a novel, four-layer superlattice, gain values as large as 90 are reported with a long wavelength cutoff of 8.7 μm at 77 K. The gain is sensitive to the structure and composition of the superlattice, and the sweepout of minority carriers is eliminated with the appropriate contacts.

1117 **Exchange-split adsorbate bands: The role of substrate hybridization.** Johnson, P.D.; Clarke, A.; Brookes, N.B.; Hulbert, S.L.; Sinkovic, B.; Smith, N.V. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **61**: No. 19, 2257-2260(7 Nov 1988).

Spin-split adsorbate-induced bands have been observed for p(1 x 1) oxygen and c(2 x 2) sulfur on Fe(001) by spin-polarized angle-resolved photoemission. For the p/sub z/ symmetry orbitals, the exchange splitting is considerably larger at the Brillouin-zone center (1.3 eV for 0, 0.5 eV for S) than at the zone edge (0.25 and 0.2 eV, respectively). This is attributed to enhanced hybridization with substrate d/sub z//sub =/ orbitals when the adsorbate p/sub z/ band overlaps the bulk continuum. Our observation of an exchange splitting provides evidence of a small magnetic moment on the adsorbate atoms. Our results also indicate that the adsorbate layer is ferromagnetically aligned with the substrate.

1118 **Breaking of the usual selection rule for magnetoluminescence in doped semiconductor quantum wells.** Lyo, S.K.; Jones, E.D.; Klem, J.F. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **61**: No. 19, 2265-2268(7 Nov 1988).

We present experimental and theoretical evidence for impurity-assisted off-diagonal (i.e., $\Delta n > 0$) transitions between conduction- and valence-band Landau levels (n = 0,1,. . .) for magnetoluminescence in modulation-doped degenerate semiconductor quantum wells. This new selection rule is employed to determine simultaneously the optical effective masses of the electrons and in-plane light holes in n-type strained GaAs/InGaAs/AlGaAs quantum wells.

1119 **Laser surface modification of metal-coated ceramics.** Singh, R.K.; Jagannadham, K.; Narayan, J. (Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695-7916). *Journal of Materials Research;* **3**: No. 6, 1119-1126(Nov 1988).

Pulsed excimer laser radiation has been successfully employed in the improvement (>50%) of fracture strength of metal coated ceramics. Thin metallic layers (~500 A) of nickel were deposited on silicon nitride and silicon carbide substrates and further irradiated with pulsed excimer (xenon chloride, krypton fluoride) laser pulses. The laser energy density was varied from 0.4 to 2.0 J cm^{-2} to optimize the formation of mixed interfacial layers. The formation of interfacial layers was studied by transmission electron microscopy and Rutherford backscattering spectrometry techniques. Detailed heat flow calculations using implicit finite difference methods were performed to simulate the effects of intense laser irradiation on metal-coated ceramic structures. Three different mechanisms were found to play an important role in the improvement in the fracture strength of these ceramics. Theoretical calculations showed that the displacement of the crack tip away from the free surface by laser surface modification can lead to a 100% improvement in the fracture strength of the ceramic.

1120 **Gaussian-shaped pulses in anisotropic solids.** Norris, A.N. (Rutgers Univ., Piscataway, NJ (USA)). pp 41-48 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A procedure was developed for modeling Gaussian wave pulse propagation in anisotropic solids and was tested on a fiber epoxy composite. Gaussian envelope broadening relative to the wave propagation velocity vector is discussed and the possible skewing effects resulting from this are assessed. Spreading rates and their dependence on pulse propagation direction are evaluated. More general initial profiles were attained by modeling the pulse as a Gauss-Hermite wave packet. It is shown that Gaussian wave packet transmission and reflection at curved interfaces can be solved. Computer-generated graphs depicting pulse orientation at various incidence angles are included.

1121 **Laser thermal wave methods in QNDE.** Opsal, J.; Rosencwaig, A. (Therma-Wave Inc., Fremont, CA (USA)). pp 215-224 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The physics of laser-generated thermal waves and their behavior in semiconductors is described from the viewpoints of solid state phenomena and nondestructive evaluation. Electron-hole plasma waves and their effects on the modulated reflectance of the beam are evaluated using wave equations for the plasma density and temperature and plasma wave diffusion length. Plasma and thermal wave responses are analyzed. Temporal and stable interface state behavior is graphed for a number of silicon wafers under various processing conditions including surface cleaning, ion implantation, and plasma etching. The modulated reflectance technique

proved to be a highly quantitative nondestructive method for characterizing the bulk transport properties in the near surface region of semiconductors and showed promise for characterizing the electronic surface states in silicon wafers.

1122 **EPR imaging investigation of damage in polymeric solids.** Bryden, W.A.; Poehler, T.O. (Johns Hopkins Univ., Laurel, MD (USA)). pp 295-298 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A mathematical deconvolution technique was demonstrated which allows electron paramagnetic resonance (EPR) image generation in materials that show complex EPR lines. The technique was applied to x-ray damaged nylon with and without the application of a magnetic field gradient where the spin densities were obtained using an inverse Fourier transform. The generation of an image of damage followed from the analogous determination of spin densities along many other orientations in the sample and the subsequent application of standard image reconstruction techniques. The method is applicable to mechanical and ionizing radiation damage in other complex solids.

1123 **Acoustographic nondestructive evaluation of composite materials.** Daniel, I.M.; Wooh, S.C.; Sandhu, J.S.; Hamidzada, W.A. (Northwestern Univ., Evanston, IL (USA)). pp 325-332 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Acoustography, analogous to radiography and photography and developed by Raj Technology, is a process of producing images with acoustic waves on an acoustically sensitive liquid crystal display. Its application to the nondestructive evaluation of composite materials was investigated. Graphite/epoxy specimens of various thickness and layups and containing various flaw types were used. The flaw types included Kapton and Mylar inclusions, porosity, and impact and fatigue damage. Sensitivity losses for the acousto-optical display and the piezoelectric detector as a function of the ultrasonic incidence angle were determined. Specimen orientation with respect to the insonifying beam was not a critical factor in sensitivity.

1124 **Electromagnetic imaging for reconstruction of flaws in advanced composites.** Treece, J.C.; Roberts, T.M.; Schunk, S.D. (Sabbagh Associates, Inc., Bloomington, IN (USA)). pp 349-356 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An experimental apparatus is described that was used to acquire eddy current data for flaw inversion. Laboratory data were compared when possible with computer calculations simulating the composite material. The experiment consisted of verifying the computer model and obtaining eddy current measurements in the advanced composite. In each experiment EMF measurements were made using inductive sensors excited by in-plane current sources near graphite-epoxy samples. These measurements, made in the 100 KHz to 10 MHz range, were proportional to the magnetic field near the material and thus described the eddy currents flowing in the composite. Computer-generated results are included.

1125 **Frequency dependent electromagnetic sensing: life monitoring - intelligent materials.** Kranbuehl, D.E.; Hoff, M.; Weller, S.; Haverty, P. (College of William and Mary, Williamsburg, VA (USA)). pp 525-531 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Experiments were conducted to demonstrate the ability of the frequency dependent output of electromagnetic sensing (FDEMS) sensors to monitor service life of high performance composite resins. The monitoring technology uses a microsensor, a thin film wafer, which can be used to measure the frequency dependent complex impedance or permittivity of the material during use as well as during fabrication and repair. Test materials included a high temperature polyimide thermoset resin, a high temperature thermoplastic resin, polyphenylene sulfide, and a graphite epoxy composite. Special emphasis was given to monitoring capacity in situ under high temperature conditions.

1126 **Localization of steel-reinforcements in concrete: determination of their diameter and cover-thickness measurement by magnetic stray flux.** Goebbels, K.; Dobmann, G. (TIEDE Risspruefanlagen, Essingen, (West Germany)). pp 533-539 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An insufficient cover thickness of concrete is the main reason for corrosion of steel reinforcements in civil engineering. A new method is presented for measuring the relevant parameters of cover thickness, steel reinforcement diameter, and corrosion conditions nondestructively. The method is based on classical Maxwell theory. A magnetic field produced by a direct current electromagnetic yoke magnetizes the steel reinforcement which results in a stray field. This field is measured by an array of Hall probes situated between the pole shoes. The measurement yields the position and diameter of the reinforcement and the cover thickness simultaneously. A prototype instrument using a 32-element array was built. Performance and resolution results are assessed.

1127 **Development of encapsulated dye for a surface impact-damage indicator system.** Light, G.M.; Schlemeus, W.; Parr, C. (Southwest Research Institute, San Antonio, TX (USA)). pp 681-689 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Southwest Research Institute recently completed a project to develop an encapsulated dye coating for an indicator system to detect surface impact in composite materials. A micro-capsule formulation process was refined so that capsules compatible with MIL-C-83286 paint could be fabricated. The capsules were circa 1 to 10 microns in diameter. Impact damage testing was conducted to determine the impact level that would damage a graphite epoxy structure. The capacity of the dye system to indicate location and intensity of the impact level was evaluated. The laboratory tests, the results, and the general chemistry are discussed.

1128 **Quantitative nondestructive evaluation of adhesive bond strength.** Gosse, J.H.; Hause, L.R. (Boeing Aerospace Co., Seattle, WA (USA)). pp 953-959 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The fabrication, physical anatomy, and nondestructive evaluation of a single lap shear bonded configuration are assessed from the viewpoint that successful nondestructive evaluation of a system of materials depends on understanding the physics of the system materials in terms of their interactions during fabrication and under service loading conditions. The lap shear system consisted of Ti-6-4 adherends which were chromic acid anodized to develop a surface oxide. An epoxy based low viscosity primer and a scrim reinforced toughened epoxy were applied. The bond was subjected to ultrasonic resonance scanning and its resonant response was mapped with a focused ultrasonic transducer. The derived data were used in closed form analytical expressions to determine the shear and normal stress distributions in the adhesive along the bond length in

the direction of the loading axis. Calculated and destructively determined failure loads are compared.

1129 **QNDE of a 3-D carbon-carbon composite using photoacoustic microscopy.** Ahmed, T.; Johnson, K.W.; Migione, A.; Monzyk, J.W.; Yang, G.; Zaman, M.; Don, J. (Southern Illinois Univ., Carbondale (USA)). pp 979-985 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The thermal anisotropy of a cylindrical weave carbon-carbon composite material was investigated by means of transmission photoacoustic microscopy. Thermal diffusivities were measured in directions parallel and perpendicular to the reinforcing fibers for the axial, radial, and circumferential yarn bundles. The average thermal diffusivity was also calculated using the estimated value of the yarn bundle fraction or fiber fraction. Calculated and experimental data are compared.

1130 **Practical application of state-of-the-art NDE techniques: evaluation of graphite-epoxy composite wing covers.** Johnston, P.H.; Kishoni, D. (NASA Langley Research Center, Hampton, VA (USA)). pp 995-1001 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

During a routine inspection of the X-29 experimental aircraft a delamination was found in the lower right wing panel. The wing cover material consists of a graphite fiber-reinforced epoxy composite laminate. The delamination was repaired by injecting a liquid epoxy into the crack. Conventional ultrasonic pulse-echo inspection was performed on the repaired area. This paper describes the measurement and signal processing procedures used in the post-repair inspection. Graphs and image plots are used to demonstrate the resolution of the procedures.

1131 **Inspecting advanced composite materials at ultrasonic frequencies from 2 megahertz to 2 gigahertz.** Thomas, G.; Odegard, B.C. (Sandia National Labs., Livermore, CA (USA)). pp 1003-1010 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Composite panels were ultrasonically inspected to evaluate their impact tolerance and to determine their integrity both before and after impact. The specimens consisted of a number of resins reinforced with fibers of graphite, glass, or Kevlar, and two non-reinforced resins. The resins tested included thermosets and a thermoplastic. C-scan techniques were used to procure images of the impact damage. From the ultrasonic images an automated damage assessment algorithm calculated the percent of damaged area in each composite. High frequency ultrasonic microscopy displayed the impact induced delaminations in sectioned samples and confirmed the ultrasonic scanner results.

1132 **Backscatter from porosity in cross-ply composites.** Qu, J.; Achenbach, J.D. (Northwestern Univ., Evanston, IL (USA)). pp 1029-1036 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The theoretical model established by the authors in an earlier paper to analyze the backscatter from a porous unidirectional fiber-reinforced composite was extended in this paper to apply to multi-ply fiber-reinforced composites. The model describes the characteristically anisotropic features of polar backscatter by taking into account the directional inhomogeneity of the composite against an anisotropic but homogeneous background. If the composite contains porosity at the ply interfaces an added backscattering component is introduced. The model is tested on a composite plate submerged in water. The wavelength was assumed to be sufficiently larger than the ply thickness to eliminate scattering by individual fibers.

1133 **Relationship between frequency dependent ultrasonic attenuation and porosity in composite laminates.** Hughes, M.S.; Handley, S.M.; Miller, J.G.; Madaras, E.I. (Washington Univ., St. Louis, MO (USA)). pp 1037-1044 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An approach was considered for correlating composite porosity and ultrasonic attenuation in anisotropic media in which the magnitude of the attenuation may preclude making measurements at sufficiently high frequencies to reach the plateau region. To evaluate the approach the slope of attenuation was measured as a function of frequency in a set of four glass-fiber/epoxy-matrix test specimens with simulated porosity (glass spheres) ranging from 1% to 12% (volume fraction) and a set of five uniaxial graphite-fiber/epoxy matrix specimens with simulated porosity ranging from 1% to 8%. Good correlation was obtained between the measured slopes and porosity in each case which suggested that semi-quantitative estimates of porosity could be achieved without measurements in the plateau region and without a quantitative theory.

1134 **Effect of bottom-surface reflections on backscatter from porosity in a composite layer.** Ohyoshi, T.; Achenbach, J.D. (Akita Univ. (Japan)). pp 1045-1052 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Polar ultrasonic backscatter produced by the bottom surface of a fiber-reinforced composite in cases where the composite is either thin or lacking enough in attenuation-causing features to allow non-negligible wave motion to reach through to this surface is discussed and a method for analyzing and extracting information from the backscatter is described. The constraints and requirements for the analysis are outlined and include an accounting for backscatter resulting from porosity. A single flat pore, characterized as a penny-shape crack, is initially considered. Then the total effect of a distribution of pores is obtained by integration around the central ray of the incident ultrasonic beam.

1135 **Characterization of porosity in continuous fiber-reinforced composites with ultrasonic backscatter.** Roberts, R.A. (Argonne National Lab., IL (USA)). pp 1053-1062 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A comparison of azimuthal backscatter scans revealed that the best discrimination between porosity levels in several multi-directional reinforced composites was obtained at relatively large polar angles and low frequency. Under these conditions the introduction of porosity caused significant changes in both the mean value and shape of the backscatter curve. Backscatter data were affected by frequency-dependent transmission properties. The resonant propagation characteristics above approximately 2.5 MHz were observed in the backscatter by using signal processing to reduce the effect of random phase information. Spectral characteristics indicative of resonant modes in the composite laminate tested were sensitive to introduced porosity.

1136 **Ultrasonic measurements of porosity in woven graphite polyimide composites.** Hsu, D.K. (Iowa State Univ., Ames (USA)). pp 1063-1068 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The method of estimating the porosity volume fraction based on the slope of ultrasonic attenuation with respect to frequency was extended to apply to woven composite laminates. Because of the woven structure the voids were mostly localized in pockets of resin and remained roughly spherical. This morphology had a large effect on the constant relating the void volume fraction to the attenuation slope. The method was tested on measurement results derived for a group of graphite polyimide composites.

1137 **Ultrasonic NDE of laser-damaged organo-matrix composites.** Tittmann, B.R.; Houston, R.; Hosten, B. (Rockwell International Science Center, Thousand Oaks, CA (USA)). pp 1069-1074 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Ultrasonic attenuation and velocity in graphite\epoxy composites damaged by real and simulated laser radiation were measured. The measurements were carried out in a water-tank ultrasonic testbed constructed to study the elastic properties of samples subjected to carbon dioxide laser radiation at a number of different scan rates. Parallel simulation studies were carried out on samples subjected to temperatures high enough to cause pyrolysis. The ultrasonic measurements were made in the 1 to 5 MHz range for varying incidence angles. Damage manifested itself in differing degrees of porosity depending on the irradiation intensity. Both attenuation and velocity were sensitive to this damage.

1138 **Mechanical strength degradation of graphite fiber reinforced thermoset composites due to porosity.** Uhl, K.M.; Lucht, B.; Jeong, H.; Hsu, D.K. (Iowa State Univ., Ames (USA)). pp 1075-1082 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The influence of porosity on compression strength, transverse tensile strength, and interlaminar shear strength was assessed for graphite/epoxy and graphite/polyimide continuous filament composite laminates. Ultrasonic followed by mechanical testing was used to demonstrate that ultrasonic parameters can be used as indicators for mechanical strength. An equation for relating porosity to strength was evaluated and one of its exponents, an empirical constant dependent upon pore size, orientation, and shape, was determined for a number of laminates to characterize the strength reduction rate. Test results on unidirectional laminates were compared with the model of Greszczuk.

1139 **Model for ultrasound transmission through graphite composite plates containing delaminations.** Margetan, F.J.; Gray, T.A.; Thompson, R.B.; Newberry, B.P. (Iowa State Univ., Ames (USA)). pp 1083-1092 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An electromechanical reciprocity relation was used to provide the formal structure for a model for the through-transmission inspection of delaminated plates. Various beam models were then combined with a Kirchhoff approximation for the scattering to predict the through-transmitted signals. A simple model was sought, employing a number of approximations, which would allow the primary variables observed in a practical experiment to be predicted with modest computational effort. The accuracies of the various model approximations were assessed by comparison to experiments in a series of quasi-isotropic graphite-epoxy laminated plates. The utility of the model and possible refinements are discussed.

1140 **Imaging of impact damage in composite materials.** Frock, B.G.; Martin, R.W.; Moran, T.J.; Shimmin, K.D. (Univ. of Dayton Research Institute, OH (USA)). pp 1093-1099 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An imaging technique is proposed which uses Wiener filtering or constrained deconvolution to remove the overlapping of echoes, or ringing, in the ultrasonic C-scan imaging of impact damage in composites. The decreased ringing in the deconvolved waveforms led to a greater dynamic range between the signal regions and the background regions of C-scan images created from these deconvolved waveforms than for C-scan images generated directly from rf waveforms. The deconvolution also performed some smoothing which resulted in the superimposition of less noise. The greater dynamic range and noise suppression allowed more precise visual and machine definition of damaged area boundaries in impacted graphite/epoxy composites.

1141 **Vibrothermographic NDE of fiberous composites.** Russell, S.S.; Lin, S.S.; Henneki, E.G. II. (Univ. of South Carolina, Columbia (USA)). pp 1101-1107 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Vibrothermography is a process for mapping the temperature on the surface of a material while the material undergoes forced mechanical vibration. This paper highlights the capabilities, advantages, and limitations of using vibrothermogaphy as a nondestructive evaluation tool for composites reinforced with fibers. The frequency dependence of exciting delaminations is discussed within the framework of a Raleigh-Ritz model for delamination. Predictions made by the model are compared with laboratory data for impact damage assessment in hybrid panels consisting of a glass polyimide honeycomb enclosed within a glass-epoxy fabric and in panels comprised of graphite epoxy.

1142 **Nondestructive evaluation of fiber composite laminates by thermoelastic emission.** Bakis, C.E.; Reifsnider, K.L. (Virginia Polytechnic Institute and State Univ., Blacksburg (USA)). pp 1109-1116 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The measurement of cyclic adiabatic thermoelastic temperature change was assessed for its effectiveness in analyzing dynamic stress or strain fields on the surface plies of graphite fiber epoxy laminates. The radiometer system used in the study was capable of resolving local stresses that reflected global stress distributions and macroscopic variations in material properties including flaws and damage. The advantages of the thermographic technique were that it was full field and rapid, required little sample preparation, was entirely non-contact, and could cover either a large or small area. Its sensitivity to manufacturing irregularities and to service load damage was demonstrated and compared to that for x-ray radiography.

1143 **Defect detection and quantification in laminated composites by EATF (passive) thermography.** McLaughlin, P.V. Jr. (Villanova Univ., PA (USA)). pp 1125-1132 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The capabilities and limitations of externally applied thermal field (EATF) thermography are presented along with applications for which it seems best suited. Heating methods are reviewed for both parallel and normal EATF thermography. Liquid crystals and

video radiometers are assessed for their temperature measurement sensitivities and ranges and techniques for the analysis of EATF thermographic phenomena are given. Detection and quantification of debonds and surface cracks are discussed along with ambient surface condition and support structure effects. Directions for future development of the technique are highlighted.

1144 **White beam synchrotron x-ray topography of gallium arsenide.** Winter, J.M. Jr.; Green, R.E. Jr.; Corak, W.S. (Johns Hopkins Univ., Baltimore, MD (USA)). pp 1153-1160 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—). Contract FG02-84ER45098.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The defect structure of gallium arsenide was investigated using white beam transmission topography. The samples were cut and polished monocrystal substrates from different suppliers. The goal of the work was to determine the viability of the method for documenting various crystallographic defect structures and establishing their effect on the performance of integrated microwave circuits fabricated on the wafers. The principles of the technique, essentially identical to classical Laue x-ray diffraction, are outlined. Two distinct defect structures were determined in the topographs. Reasons for the defect structures were postulated and the application of the method for quality control assessments of manufacturer-supplied gallium arsenide substrates was assessed.

1145 **Correlation of thin-film bond compliance and bond fracture resistance.** Addison, R.C. Jr.; Marshall, D.B. (Rockwell International Science Center, Thousand Oaks, CA (USA)). pp 1185-1194 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Scanning acoustic microscopy was used to make local measurements of film disbonds and film bond compliance based on the changes in the surface acoustic wave velocity in layered media. Results of these measurements for chrome/gold and gold films on glass substrates are summarized. The compliance of the bond and its fracture energy were correlated in some film systems. Results from an experiment to determine if this correlation existed for chrome/gold and gold films on sapphire substrates are described.

1146 **Evaluation of solder bonds in a silicon flip chip device.** Fanton, J.T.; Chou, C.H.; Khuri-Yakub, B.T.; Kino, G.S. (Stanford Univ., CA (USA)). pp 1195-1202 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—). Contract FG03-84ER45157;AS03-81ER10865.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Two nondestructive techniques were demonstrated for evaluating the quality of solder joints in flip chip devices. They include acoustic microscopy and photothermal measurements. Both methods circumvented the major difficulty, the fact that the bonds are obscured by the silicon wafers, in imaging these devices. The acoustic images showed where solder bumps had been pulled off the substrates while the photothermal technique was useful in evaluating bonds that initially made incomplete contact. Both techniques are diagramed and acoustic and photothermal images are included.

1147 **Laser optic vibration sensing for the inspection of bonds in the orbiter thermal protection tiles.** Barna, B.A.; Allemeier, R.T.; Rodiguez, J.G. (EG & G Idaho Inc., Idaho Falls (USA)). pp 1227-1235 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC07-76ID01570.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The use of a noncontact acousto-optic sensor for the detection of bonding flaws in the silica fiber composite tiles used for the Space Shuttle Orbiter was evaluated. Submicron vibration displacements of the tile surface were sensed using a frequency stabilized helium-neon laser and signal processing was performed using a computerized NDE workstation. The method rested on the premise that a bonded structure would exhibit varying dynamic responses to an excitation pulse that depended on the boundary conditions defined by the bonded area. The laser acoustic sensor allowed rapid measurement without perturbing the response or damaging the surface. Speckle interferometry was also used as a coherent light imaging technique for real-time visualization of the tile vibration modes and to study the mode shapes and their behavior as the bond degraded.

1148 **Ultrasonic characterization of nonuniform porosity distribution in SiC ceramic.** Telschow, K.; Walter, J.; Kunerth, D. (EG & G Idaho, Inc., Idaho Falls (USA)). pp 1285-1292 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC07-76ID01570.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Porosity distribution in SiC was studied by attenuation and scattering measurements and by measuring changes in the velocity of ultrasonic waves. Velocity mapping gave the most accurate and quantitative results, even in light of the phase cancellation effects produced by the porosity nonuniformity. In addition, these results could be explained by the net effect of Rayleigh scattering from a large density of very small pores, which maintained the results in the weak scattering density regime. Attenuation mapping proved to be impossible due to severe echo modulation effects caused by phase cancellation across the wavefront due to the observed velocity gradients in the sample. Several unique properties of the porosity distribution were resolved. Results are correlated with x-ray and optical microscopy data.

1149 **Acoustic characterization of curing processes using waveguides embedded within polymers.** Harrold, R.T.; Sanjana, Z.N. (Westinghouse R & D Center, Pittsburgh, PA (USA)). pp 1549-1553 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The versatility of the acoustic waveguide cure monitoring of graphite-epoxy AS4/3501-6 composites was demonstrated in experiments using waveguides of polyester-fiberglass, copper, nichrome, and graphite-epoxy. A pattern emerged for this form of cure monitoring in which large acoustic wave attenuation changes started at the beginning of gelation and maximized at the gelation point. The critical gelation period could also be monitored by changes in wave velocity or transit time. Acoustic impedance measurements of the waveguide and composite materials led to an estimate of acoustic wave reflection at the interface and accurately predicted maximum acoustic wave transmission within the nichrome waveguide.

1150 **Use of marginal oscillator for acoustic monitoring of curing of epoxy resin.** Thomas, L.J. (GE Corporate Research and Development, Schenectady, NY (USA)). pp 1555-1562 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A measurement system was developed which uses the epoxy resin as a narrowband ultrasonic resonator placed in the feedback loop of an amplifier. Using gain control the system is allowed to marginally oscillate. The frequency of oscillation depends on the velocity of ultrasound in the resin while the gain necessary to maintain stable oscillations depends on the attenuation of the resin. The use of the narrowband resonant technique resulted in a monitoring

system which was accurate, stable, and could be produced at reasonable cost. Schematic diagrams of the system are given.

1151 **Cure control: strategies for using dielectric sensors.** Day, D.R. (Micromet Instruments, Inc., Cambridge, MA (USA)). pp 1573-1579 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A technique involving the use of microdielectric sensors and process control software was developed for monitoring the dielectric permittivity and loss factor and for extracting the ionic conductivity values in composite polymers. The use of first and second derivative information (log ionic conductivity with respect to time) was investigated for closed loop control of certain key processing steps during composite curing. The technique was shown to be capable of detecting viscosity minima, onset of reaction, and end point.

1152 **Method of applying coatings to substrates and the novel coatings produced thereby.** Hendricks, C.D. US Patent Application 6-096,200. 15 Sep 1987. 26p. Contract W-7405-ENG-48. NTIS, PC A03/MF A01.

A method for applying novel coatings to substrates is provided. The ends of a multiplicity of rods of different materials are melted by focused beams of laser light. Individual electric fields are applied to each of the molten rod ends, thereby ejecting charged particles that include droplets, atomic clusters, molecules, and atoms. The charged particles are separately transported, by the accelerations provided by electric potentials produced by an electrode structure, to substrates where they combine and form the coatings. Layered and thickness graded coatings comprised of hitherto unavailable compositions, are provided. 2 figs.

1153 **Laser-driven fusion etching process.** Ashby, C.I.H.; Brannon, P.J.; Gerardo, J.B. US Patent Application 6-089,206. 25 Aug 1987. 16p. Contract AC04-76DP00789. NTIS, PC A03/MF A01.

The surfaces of solids are etched by a radiation-driven chemical reaction. The process involves exposing a substrate coated with a layer of a reactant material on its surface to radiation, e.g., a laser, to induce localized melting of the substrate which results in the occurrence of a fusion reaction between the substrate and coating material. The resultant reaction product and excess reactant salt are then removed from the surface of the substrate with a solvent which is relatively inert towards the substrate. The laser-driven chemical etching process is especially suitable for etching ionic substrates, e.g., $LiNbO_3$, such as used in electro-optical/acousto-optic devices. It is also suitable for applications wherein the etching process is required to produce an etched ionic substrate having a smooth surface morphology or when a very rapid etching rate is desired.

1154 **Method for wetting a boron alloy to graphite.** Storms, E.K. US Patent Application 6-087,932. 21 Aug 1987. 11p. Contract W-7405-ENG-36. NTIS, PC A03/MF A01.

A method is provided for wetting a graphite substrate and spreading a a boron alloy over the substrate. The wetted substrate may be in the form of a needle for an effective ion emission source. The method may also be used to wet a graphite substrate for subsequent joining with another graphite substrate or other metal, or to form a protective coating over a graphite substrate. A noneutectic alloy of boron is formed with a metal selected from the group consisting of nickel (Ni), palladium (Pd), and platinum (Pt) with excess boron, i.e., and atomic percentage of boron effective to precipitate boron at a wetting temperature of less than the liquid-phase boundary temperature of the alloy. The alloy is applied to the substrate and the graphite substrate is then heated to the wetting temperature and maintained at the wetting temperature for a time effective for the alloy to wet and spread over the substrate. The excess boron is evenly dispersed in the alloy and is readily available to promote the wetting and spreading action of the alloy. 1 fig.

1155 **Coating formulation and method for refinishing the surface of surface-damaged graphite articles.** Ardary, Z.L.; Benton, S.T. US Patent Application 6-071,102. 8 Jul 1987. 9p. Contract AC05-84OS21400. NTIS, PC A02/MF A01.

The described development is directed to a coating formulation for filling surface irregularities in graphite articles such as molds, crucibles, and matched die sets used in high-temperature metallurgical operations. The coating formulation of the present invention is formed of carbon black flour, thermosetting resin and a solvent for the resin. In affixing the coating to the article, the solvent is evaporated, the resin cured to bond the coating to the surface of the article and then pyrolyzed to convert the resin to carbon. Upon completion of the pyrolysis step, the coating is shaped and polished to provide the article with a surface restoration that is essentially similar to the original or desired surface finish without the irregularity.

1156 **Field-effect transistor having a superlattice channel and high carrier velocities at high applied fields.** Chaffin, R.J.; Dawson, L.R.; Fritz, I.J.; Osbourn, G.C.; Zipperian, T.E. US Patent Application 6-059,365. 8 Jun 1987. 19p. Contract AC04-76DP00789. NTIS, PC A03/MF A01.

A field effect transistor comprises a semiconductor having a source, a drain, a channel and a gate in operational relationship. The semiconductor is a strained layer superlattice comprising alternating quantum well and barrier layers, the quantum well layers and barrier layers being selected from the group of layer pairs consisting of InGaAs/AlGaAs, InAs/InAlGaAs, and InAs/InAlAsP. The layer thicknesses of the quantum well and barrier layers are sufficiently thin that the alternating layers constitute a superlattice which has a superlattice conduction band energy level structure in k-vector space. The layer thicknesses of the quantum well layers are selected to provide a superlattice L/sub 2D/-valley which has a shape which is substantially more two-dimensional than that of said bulk L-valley. 2 figs.

1157 **Glass-ceramic hermetic seals to high thermal expansion metals.** Kramer, D.P.; Massey, R.T. US Patent Application 6-043,526. 28 Apr 1987. 33p. Contract AC04-76DP00053. NTIS, PC A03/MF A01.

A process for forming glass-ceramic materials from an alkaline silica-lithia glass composition comprising 60-72 mole-% SiO_2, 18-27 mole-% Li_2O, 0-5 mole-% Al_2O_3, 0-6 mole-% K_2O, 0-3 mole-% B_2O_3, and 0.5-2.5 mole-% P_2O_5, which comprises heating said glass composition at a first temperature within the 950-1050{degree}C range for 5-60 minutes, and then at a devitrification temperature within the 700-900{degree}C range for about 5-300 minutes to obtain a glass-ceramic having a thermal expansion coefficient of up to 210 x 10/sup {minus}7//{degree}C. These ceramics form strong, hermetic seals with high expansion metals such as stainless steel alloys. An intermediate nucleation heating step conducted at a temperature within the range of 675-750{degree}C for 10-120 minutes may be employed between the first stage and the devitrification stage. 1 fig., 2 tabs.

1158 **Electrically induced mechanical precompression of ferroelectric plates.** Chen, P.J. US Patent Application 6-020,996. 2 Mar 1987. 12p. Contract AC04-76DP00789. NTIS, PC A03/MF A01.

A method of electrically inducing mechanical precompression of ferroelectric plate covered with electrodes utilizes the change in strains of the plate as functions of applied electric field. A first field polarizes and laterally shrinks the entire plate. An outer portion of the electrodes are removed, and an opposite field partially depolarizes and expands the central portion of the plate against the shrunk outer portion. 2 figs.

1159 **Method of synthesizing a low density material.** Lorensen, L.E.; Monaco, S.B. US Patent Application 6-019,840. 27 Feb 1987. 14p. Contract W-7405-ENG-48. NTIS, PC A03/MF A01.

A novel method of synthesizing a polymeric material of low density of the order of 50mg/cc or less. Such a low density material has applications in many areas including laser target fabrication. The method comprises preparing a polymer blend of two incompat-

ible polymers as a major and a minor phase by mixing them and extruding the mixture, and then selectively extracting the major component, to yield a fine, low density structure.

1160 (LA-tr—88-19) Formation mechanism of poly (p-oxybenzoyl) whiskers. Yamashita, Yuhiko; Kato, Yasuo; Endo, Eiji; Kunio, Kimura; Tsugita, Hiroshi. Translated from *Kobunshi Ronbunshu ;* **44**: No. 1, 41-44(1987). Contract W-7405-ENG-36. 12p. NTIS, PC A03/MF A01. Order Number DE89001772/JAW.

From electron ray diffraction figures, POB needle shape crystals obtained in the last report were found to be extended chain type crystals with high crystallinity. And the formation mechanism of this whisker was thought to be the following from observing the morphology of initial stages of polymerization. Oligomer molecules reaching a certain polymerization degree by condensing in a solvent, precipitate as lamellae crystals. Moreover, the oligomer molecules crystallize in spiral growth due to the screw dislocation occurring on the lamellae crystal, and the lamellae piles up high. After that, post polymerization occur and the oligomer molecules between lamellaes condense and become extended chain type crystals. Also, by the polymerization conditions of solvents used, other morphologies are observed, but basically, it was similar polymerized crystallization mechanism. 5 refs., 7 figs.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 321, 326, 331, 378, 645, 884, 885, 889, 1592, 1908

1161 (CEGB-RD/B—6001/R88) Study of a number of mixed transition metal oxide spinels using X-ray photoelectron spectroscopy. Allen, G.C.; Jutson, J.; Dyke, J.M.; Harris, S.J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.; Southampton Univ. (UK)). (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Mar 1988. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755436/JAW.

X-ray photoelectron spectra have been recorded from 5 series of characterised iron-chromium containing spinels. MnFesub(x) Crsub(2-x)O/sub 4/, Mnsub(1-x)Fesub(x) Cr/sub 2/O/sub 4/, Fesub(x)Crsub(3-x)O/sub 4/, CoFesub(x) Crsub(2-x)O/sub 4/ and NiFesub(x) Crsub(2-x)O/sub 4/. Manganese 2psub(3/2) peak binding energies in the range of 640.0 to 641.3 eV were recorded from samples taken from both series of manganese spinels. Significant changes were noted in the nickel 2p photoelectron spectra and attributed to the displacement of the nickel (II) cation from octahedral to tetrahedral lattice positions. These changes included large shifts in the Ni 2psub(3/2) peak binding energy plus intensity and positional changes in the associated satellite structure. Shifts were also observed in the chromium 2p spectra which were related to the variation in sample composition. These shifts followed two distinct trends. Quantitative XPS analysis identified the surface segregation of chromium ions during the preparation of cobalt spinels and the segregation of both iron and chromium in the nickel containing compounds.

1162 (DOE/ER/13552—3) Simulation and optimization of three-phase distillation processes. Kingsley, J.P.; Lucia, A. (Clarkson Univ., Potsdam, NY (USA). Dept. of Chemical Engineering). Jun 1988. Contract FG02-86ER13552. 41p. NTIS, PC A03/MF A01. Order Number DE89001786/JAW.

The relationship between two-phase and three-phase solutions to heterogeneous distillation simulation and optimization problems is studied. Simulation results illustrate that bifurcation points can occur in the two-phase solutions and that in regions of steady-state two-phase solution multiplicity not all two-phase solutions can be used to compute a three-phase solution. Numerical difficulties are attributed to marked differences in the separation performed by the two- and three-phase solutions and to ill-conditioning when a second liquid phase is present in small amount. The optimization study shows that :multiple local optima with different numbers of three-phase trays can occur. These local optima need not be spurious, and indicate that some global optimization method is required to guarantee the correct solution is located. Accordingly, the tunneling algorithm for global optimization is used to solve a three-phase distillation optimization problem. Results show that tunneling can be used to successfully find the global solution. 40 refs., 7 figs., 6 tabs.

1163 (ECN—196) On-line radiometry in high-performance liquid chromatography using a storage loop. Nieuwkerk, H.J. van. (Netherlands Energy Research Foundation, Petten). Jan 1987. 144p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88780133/JAW.

Difficulty with radiometric chromatography is that large measured volumes are required for accurate detections, but large volumes cause band widening and thus poor separation capacity. The solution proposed here is based on the use of a capillary storage loop for temporary residence of the column eluate. To avoid back mixing, the liquid is interspaced with a second, immiscible, phase ('spacer') so as to form a sequence of small 10-50 3=1 separate segments. This train passes the on-line radiometric detector to obtain a first scan of the chromatograms, called the 'direct' measurement. It then reaches the storage loop. The usual on-line UV measurement is done in the same run. The eluate cum spacer is, at a later stage, pumped through the detector at a greatly reduced flow rate to obtain the 'reversed' or 'delayed' measurement. Beta-detection is based on liquid scintillation. Accordingly, the (organic) liquid scintillant is used as the 'spacer'. In most cases it is possible to extract the analyte from the aqueous eluate into the organic phase during transport to and storage in the loop. This ensures a high counting efficiency. If the analyte is non-extractable, the counting efficiency is considerably less but the number of counts collected is still sufficient for quantitative assay, due to the extended counting time. The report is divided into 5 chapters, each dealing with a radiometric HPCL separation making use of this method. 36 figs., 124 refs., 16 tabs.

1164 (GKSS—88/E/19) Development of liquid-chromatographic methods to determine heavy metal contents within ppB range, and applicability to analytical specification of metals in aqueous solutions. Schmidt, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Kiel Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 1988. 259p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88755235/JAW.

Three liquid-chromatographic methods are developed to determine heavy metal contents within the ppB-range. The determination of the bulk content is carried out and analytical results are compared with the data from AAS. Additionally thermodynamic and kinetic methods are developed allowing to determine the speciation of a certain metal. Analytical data are compared with results from calculated models. Synthetic water samples are analyzed and the applicability of these methods for natural samples is checked. (orig.) With 134 figs., 36 tabs.

1165 (INIS-mf—11316) 8th Czechoslovak spectroscopic conference. Abstracts. Section A - atomic spectroscopy. (Ceskoslovenska Spektroskopicka Spolecnost, Prague). 1988. 108p. (CONF-8806259—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88704353/JAW.

From 8. Czechoslovak spectroscopic conference; Ceske Budejovice, Czechoslovakia (19 Jun 1988).

Volume 1 of the conference proceedings contains abstracts of 15 invited papers, 54 poster presentations and 10 papers of instrument manufacturers, devoted to atomic spectroscopy. Abstracts of 2 poster presentations were inputted in INIS, both dealing with the evaporation of rare earth elements in dc arcs. (A.K.).

1166 (INIS-mf—11316, pp 51) **Investigation of the processes of evaporation of rare earth elements in direct current arc.** Herkelova, M.; Buchta, S. (Slovenska Akademia Vied, Bratislava (Czechoslovakia)). 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88704353/JAW. (CONF-8806259—).

From 8. Czechoslovak spectroscopic conference; Ceske Budejovice, Czechoslovakia (19 Jun 1988).

1167 (INIS-mf—11316, pp 52) **Influence of spectrochemical additives upon the rare earth elements evaporation in D.C. arc excitation.** Terpakova, E.; Florian, K. (Vysoka Skola Technicka, Kosice (Czechoslovakia)). 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88704353/JAW. (CONF-8806259—).

From 8. Czechoslovak spectroscopic conference; Ceske Budejovice, Czechoslovakia (19 Jun 1988).

1168 (INT—181/I) **Determination of trace concentration of selenium in air particulates by energy-dispersive X-ray fluorescence method.** Holynska, B.; Markowicz, A.; Ostachowicz, B. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1983. 13p. (In Polish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704572/JAW.

Received in 1986.

A method for the determination of trace concentrations of selenium in air-particulates with no preliminary chemical preparation has been worked out. Radioisotope energy-dispersive X-ray fluorescence method has been used and thin samples techniques has been applied. Lower limit of detection and precision of selenium determination have been estimated. 6 refs., 3 figs., 1 tab.

1169 (PB—88-235502/XAB) **Determination of pH by flow-injection analysis and by fiber-optrode analysis.** Pia, S.H.; Waltman, D.P.; Hillman, D.C. (Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV (USA)). Jul 1988. 55p. NTIS, PC A04/MF A01.

Two new procedures for measuring pH were developed. The first measures pH colorimetrically using a proprietary indicator-dye mixture in a flow injection analysis (FIA) procedure. The second measures pH using a fiber-optic chemical sensor (FOCS) specifically developed for pH determinations. The FOCS method measures pH by monitoring the fluorescence of a fluorescein derivative bonded to the distal end of a fiber-optic cable called an optrade. The FIA method currently has a precision and accuracy of about + or - 0.2 pH units and can measure 100 samples/hour. The FOCS method has a precision of + or - 0.05-0.20 pH units and an accuracy of + or - 0.1 to 0.6 pH units. About 10 to 60 samples can be analyzed. The characteristics of the FOCS Method will vary significantly with individual optrodes. The experimental results indicate that either flow-injection analysis or fiber optic chemical sensor analysis could form the basis for an alternative to electrometric measurement of pH in certain circumstances.

1170 (PB—88-868500/XAB) **Ion exchange resins. January 1970-August 1988 (Citations from the US Patent data base). Report for January 1970-August 1988.** (National Technical Information Service, Springfield, VA (USA)). Aug 1988. 90p. NTIS PC N01/MF N01.

This bibliography contains citations concerning preparation, regeneration, and applications of ion-exchange resins. Applications include water and waste treatment; food processing; chemical recovery, separation, purification, and catalysis; desalination; and ore treatment and recovery. Methods are included for the processing of spent ion exchange resins and of protecting ion exchange resins from oxidation and chemical degradation. (Contains 227 citations fully indexed and including a title list.)

1171 **Rapid laser-wavelength modulation spectroscopy used as a fast temperature measurement technique in hydrocarbon combustion.** Rea E.C. Jr.; Hanson, R.K. (Stanford University, Department of Mechanical Engineering, High Temperature Gasdynamics Laboratory, Stanford, California 94305). *Applied Optics;* **27**: No. 21, 4454-4464(1 Nov 1988).

A fast temperature measurement technique is described which is suitable for use in dynamic reacting gases, particularly in situations which involve hydrocarbon—air combustion. Temperature is determined from the relative intensity of a pair of fully resolved absorption lines probed with a rapid-tuning single-frequency laser. Demonstration of the technique using 300-μs scans across the $R_1(7)$ and $R_1(11)$ lines in the (0,0) band of the A^2summation$^+$ left-arrow X^2product system of OH present in the postflame gases above a CH_4—air flat-flame burner is reported. Fluorescence monitoring of the absorption spectra was used to provide improved spatial resolution. Temperatures inferred from simultaneous absorption and fluorescence measurements showed good agreement with radiation-corrected thermocouple scans.

1172 **Computer simulation of the propagation of a large concentration band in liquid chromatography.** Guiochon, G.; Golshan-Shirazi, S.; Jaulmes, A. (Univ. of Tennessee, Knoxville (USA)). *Analytical Chemistry;* **60**: No. 18, 1856-1866(15 Sep 1988).

The injection of large amounts of sample in a liquid chromatography column is often carried out for preparative reasons, sometimes for trace analysis. In all cases it results in the formation of a high-concentration band, the profile of which is broader than that of a band of a much smaller amount of the same compound and is most often asymmetrical. This phenomenon is often described as a loss of efficiency taking place when the column is overloaded. In fact, it arises from the nonlinearity of the equilibrium isotherm of the studied solute between the mobile and the stationary phase. Using a theoretical model based on the mass balance equations of the solute and mobile in a column slice, the authors describe the change in band profile during elution and the influence of various parameters on the elution profile: sample size, injection duration, shape of the equilibrium isotherm, slope and curvature of the isotherm at the origin, and normal column efficiency. The most important single factor that determines the elution profile is the shape of the isotherm around the origin, i.e., the sign and magnitude of the curvature at zero concentration, the rate of variation of this curvature with increasing concentration, and the possible existence of an inflection point. As a consequence, extreme accuracy of the isotherm is required to relate quantitatively the equilibrium isotherm and the elution profiles.

1173 **Development of antibody-based fiber optic sensors for detection of a benzo[a]pyrene metabolite.** Tromberg, B.J.; Sepaniak, M.J.; Alarie, J.P.; Vo-Dinh, T.; Santella, R.M. (Univ. of Tennessee, Knoxville (USA)). *Analytical Chemistry;* **60**: No. 18, 1901-1908](15 Sep 1988). Contract AC05-84OR21400.

This paper describes the development of an antibody-based fiber-optic sensor designed to detect benzo[a]pyrene (BP) metabolites, in this case, r-7,t-8,9,c-10-tetrahydroxy-7,8,9,10-tetrahydrobenzo[a]pyrene (benzopyrenetetraol or BPT), a naturally fluorescent hydrolysis product of DNA adducts that forms during PB metabolism. The sensor's principle of operation is based on diffusion of BPT into the fiber's reagent phase where it complexes with monoclonal anti-BPT antibody. Reagent phase is immobilized inside a reusable sensing tip. It consists of either membrane-entrapped liquid antibody or antibody immobilized on 7-μm silica beads. The antibody binds and concentrates BPT in the fiber's viewing region until equilibrium with the sample is achieved. Typical measurements are performed in 15 min under nonequilibrium conditions. The 325-nm line of a He:Cd laser provides excitation of the immune complex. The intensity of the resulting fluorescence emission is directly proportional to the amount of BPT in the sample. Sensor response rate varies with BPT concentration in the sample and, under certain circumstances, with antibody concentration in the sensor. At high antibody concentrations, sensor response rate is linear for about 2 h. For 15-min incubations, typical limits of detection are 5×10^{-10} M. Significant chemical selectivity is also demonstrated despite the presence of structurally and spectrally similar polynuclear aromatic (PNA) interferents.

1174 **Determination of carboxylic acids by isotope dilution gas chromatography/Fourier transform infrared spectroscopy.** Olson, E.S.; Diehl, J.W.; Froehlich, M.L. (Univ. of North Dakota Energy and Mineral Research Center, Grand Forks (USA)). *Analytical Chemistry;* **60**: No. 18, 1920-1924(15 Sep 1988). Contract FC21-86MC10637.

A method has been developed for determining carboxylic acids by isotope dilution with ^{18}O-enriched carboxylic acids and measurement of the isotope ratio in methyl esters of the analyte and standard mixture by capillary gas chromatography/Fourier transform infrared (GC/FTIR) spectroscopy. The difference in the carbonyl absorption maxima for the analyte and standard esters allowed separate absorbance chromatograms to be reconstructed by integration over two narrow frequency ranges in each analyte/standard GC/FTIR spectrum. Area ratios obtained from the absorbance reconstructed chromatograms were plotted versus concentration ratios to give a nonlinear calibration plot, which was expressed as a third-order polynomial by least-squares polynomial fitting. The method was more accurate than GC/MS method developed with the same standards, analytes, and range of concentrations. The isotope dilution GC/FTIR method was applied to the quantitative analysis of aqueous mixtures of coal oxidation products.

1175 **Improved electrospray ionization interface for capillary zone electrophoresis-mass spectrometry.** Smith, R.D.; Barinaga, C.J.; Udseth, H.R. (Pacific Northwest Lab., Richland, WA (USA)). *Analytical Chemistry;* **60**: No. 18, 1948-1952(15 Sep 1988). Contract AC06-76RL01830.

A new electrospray ionization interface for capillary zone electrophoresis-mass spectrometry (CZE-MS) is described. The interface uses a sheath flow of liquid to make the electrical contact at the CZE terminus, thus defining both the CZE and electrospray field gradients. This allows the composition of the electrosprayed liquid to be controlled independently of the CZE buffer, providing operation with buffers that could not be used previously (e.g., aqueous and high ionic strength buffers). The interface operation is independent of CZE flow rate; CZE capillaries are easily replaced and require no additional preparation. Since the electrospray occurs directly from the CZE capillary terminus, additional mixing volumes and metal surfaces are avoided and electrophoretic separation efficiency appears unperturbed. The dead volume associated with the electrospray interface is < 10 nL, corresponding to < 0.1 s for typical flow rates of the sheath electrode liquid. CZE-MS separations for mixtures of quaternary phosphonium salts and for epinephrine and related amines are demonstrated. Operation is demonstrated with high surfactant concentrations, as required for capillary electrokinetic chromatography. The extension to other capillary electrophoresis methods, such as isotachophoresis and isoelectric focusing, appears feasible.

1176 **Separation efficiency of slurry-packed liquid chromatography microcolumns with very small inner diameters.** Karlsson, K.E.; Novotny, M. (Pharmaceutical Research and Development, Moelndal (Sweden)). *Analytical Chemistry;* **60**: No. 18, 1662-1665(1 Sep 1988). Contract FG02-84ER60215.

Fused silica capillaries of different diameters were slurry-packed with an identical sorption material and evaluated chromatographically. The extent of band broadening was evaluated fluorometrically at different column lengths, together with porosity measurements obtained from a fluorescence-quenching marker. Kinetic analysis of the plate-height vs velocity data reveals that the inner diameter is a very important variable in the preparation of such packed columns. Extremely high efficiencies were obtained with columns of the smallest diameter (44 μm).

1177 **Separation of silver from other metal cations using pyridone and triazole macrocycles in liquid membrane systems.** Izatt, R.M.; LindH, G.C.; Bruening, R.L.; Huszthy, P.; McDaniel, C.W.; Bradshaw, J.S.; Christensen, J.J. (Brigham Young Univ., Provo, UT (USA)). *Analytical Chemistry;* **60**: No. 17, 1694-1699(1 Sep 1988). Contract FG02-86ER13463.

Selective transport of Ag^+ over other metal ions in competitive experiments in bulk and emulsion liquid membrane systems has been accomplished by using macrocycles of the proton-ionizable pyridone and triazole types. The transport of Ag^+ by the pyridone macrocycles involves the cotransport of an anion, while transport by the triazole macrocycles can involve either co-anion transport or the counter transport of H^+. In particular, the affinity of Ag^+ for the triazole moiety, the excellent fit of Ag^+ into an 18-crown-6 sized cavity, and the presence of only one proton-ionizable site per macrocycle molecule combine to produce highly selective transport of Ag^+ over Pb^{2+} and Tl^+ with triazolo-18-crown-6 derivatives in membrane systems containing acid receiving phases. Transport of alkali-, alkaline-earth-, and several transition-metal cations is minimal in similar membrane systems and, hence, selective transport of Ag^+ over these cations is also expected.

1178 **Pulsed laser resonance ionization mass spectrometry for elementally selective detection of lead and bismuth mixtures.** Fearey, B.L.; Miller, C.M.; Rowe, M.W.; Anderson, J.E.; Nogar, N.S. (Los Alamos National Lab., NM (USA)). *Analytical Chemistry;* **60**: No. 17, 1786-1791(1 Sep 1988). Contract W-7405-ENG-36.

Pulsed laser, single-color, (2 + 1) multiphoton ionization is used to achieve elemental selectivity while concurrently eliminating isobaric interferences for lead (Pb) and bismuth (Bi) mixtures detected via resonance ionization mass spectrometry. Experimental results are compared with theoretical calculations by using a simple rate equation formalism. The following oscillator strengths were determined: Pb, $6p7p\ ^3P_0$ reverse arrow $6p7s\ ^3P_1{}^0$, f = 0.4 +/- 0.1; Bi, $6p^2\ (^3P_0)\ 7p\ J = 3/2^0$ reverse arrow $6p^27s\ ^4P/sub\ 1/2/$, f = 0.07 +/- 0.02. In addition, the Bi ionization cross section at 64,412 cm^{-1} was estimated to be (5 +/- 2) x 10^{-18} cm^2. Relative efficiencies of the ionization processes for these elements and a comparison between pulsed and continuous laser excitation are discussed.

1179 **Indirect fluorescence detection of native amino acids in capillary zone electrophoresis.** Kuhr, W.G.; Yeung, E.S. (Iowa State Univ., Ames (USA)). *Analytical Chemistry;* **60**: No. 17, 1832-1834(1 Sep 1988). Contract W-7405-ENG-82.

Amino acids are but one of several important classes of small chemical compounds in biological chemistry that have an inherent lack of analytically useful physical properties. Amino acids, peptides, fatty acids, sugars, many mono-, di-, and tricarboxylic acids, and phosphorylated intermediates in glycolysis and metabolism show little, if any, UV or visible absorption, fluorescence, or electrochemical activity. As the emphasis of biochemical research shifts to smaller samples where, for example, picomolar quantities of amino acids are analyzed in gas phase protein sequencing or in microliter samples of the extracellular fluid of the mammalian brain, the analytical problem becomes even more challenging due to the small volume of sample available for analysis. In this work, laser-induced fluorescence spectroscopy is performed on-column to detect the bands separated with capillary zone electrophoresis (CZE). CZE is an instrumental form of zone electrophoresis where chemical species are separated purely on the basis of their electrophoretic mobility, since no supporting gel is utilized. Both anions and cations can be separated in the same run because of the large electroosmotic flow generated in small diameter capillaries. This technique has already been used successfully in the rapid, efficient separation of dansyl-amino acids.

1180 **Aperture-based thermospray vaporizer.** Koropchak, J.A.; Aryamanya-Mugisha, H. (Southern Illinois Univ., Carbondale (USA)). *Analytical Chemistry;* **60**: No. 17, 1838-1840(1 Sep 1988). Contract FC22-87PC79863.

Thermospray is a means of aerosol generation that has gained great popularity as an interface between high-pressure liquid chromatography (HPLC) and mass spectrometry (MS). Aerosols generated by thermospray have also been found to be advantageous for liquid sample introduction to inductively coupled plasma atomic emission spectrometry (ICP-AES). In this report, the authors will describe a modification of their original chemically robust thermospray vaporizers that provides for rapid repair/cleaning of clogged vaporizers. The system is based on the use of laser-drilled stainless steel apertures and provides additional flexibility for the selection of vaporizer exit internal diameter.

1181 Pilot testing of radioluminescent lights for remote airfields. Jensen, G.A.; Hazelton, R.F.; Moles, R.G. (Pacific Northwest Lab., Richland, WA (US)). *Nuclear Technology;* **82**: No. 1, 81-93(Jul 1988).

Alaska and other far northern areas have special logistic, environmental, and economic problems that make radioluminescent (RL) lighting, particularly at airfields, an attractive alternative to electrical systems and flare pots. Tests and demonstrations of prototype systems conducted in Alaska in recent years have proved the basic technological worth of RL airport lighting systems for civilian and military use. If regulatory issues and other factors identified in these tests can be favorably resolved and if the system and its components can be refined through production engineering, highly useful applications for RL airfield lighting systems in Alaska and other remote locations can result.

1182 Method for the substantial reduction of quenching effects in luminescence spectrometry. Demas, J.N.; Jones, W.M.; Keller, R.A. US Patent Application 6-068,005. 26 Jun 1987. 26p. Contract W-7405-ENG-36. NTIS, PC A03/MF A01.

Method for reducing quenching effects in analytical luminescence measurements. Two embodiments of the present invention are described which relate to a form of time resolution based on the amplitudes and phase shifts of modulated emission signals. In the first embodiment, the measured modulated emission signal is substantially independent of sample quenching at sufficiently high frequencies. In the second embodiment, the modulated amplitude and the phase shift between the emission signal and the excitation source are simultaneously measured. Using either method, the observed modulated amplitude may be reduced to its unquenched value. 3 figs.

1183 Molten salt extraction process for the recovery of valued transition metals from land-based and deep-sea minerals. Maroni, V.A.; von Winbush, S. US Patent Application 6-044,618. 1 May 1987. 11p. Contract W-31109-ENG-38. NTIS, PC A03/MF A01.

A process for extracting transition metals and particularly cobalt and manganese together with iron, copper and nickel from low grade ores (including ocean-floor nodules) by converting the metal oxides or other compositions to chlorides in a molten salt, and subsequently using a combination of selective distillation at temperatures below about 500{degree}C, electrolysis at a voltage not more negative that about {minus}1.5 volt versus Ag/AgCl, and precipitation to separate the desired manganese and cobalt salts from other metals and provide cobalt and manganese in metallic forms or compositions from which these metals may be more easily recovered.

1184 Extraction process for removing metallic impurities from alkalide metals. Royer, L.T. US Patent Application 6-028,267. 20 Mar 1987. 8p. Contract AC05-84OR21400. NTIS, PC A02/MF A01.

A development is described for removing metallic impurities from alkali metals by employing an extraction process wherein the metallic impurities are extracted from a molten alkali metal into molten lithium metal due to the immiscibility of the alkali metals in lithium and the miscibility of the metallic contaminants or impurities in the lithium. The purified alkali metal may be readily separated from the contaminant-containing lithium metal by simple decanting due to the differences in densities and melting temperatures of the alkali metals as compared to lithium.

4002 Inorganic, Organic And Physical Chemistry

REFER ALSO TO CITATION(S) 34, 73, 122, 128, 217, 252, 379, 691, 845, 893, 1160, 1844, 1846, 2115, 2440

1185 (AD-A—195778/6/XAB) Amino acid sequence of human cholinesterase. Annual report, 30 September 1984-30 September 1985. Lockridge, O. (American Rice, Inc., Houston, TX). Oct 1985. 25p. NTIS, PC A03/MF A01.

The active-site serine residue is located 198 amino acids from the N-terminal. The active-site peptide was isolated from three different genetic types of human serum cholinesterase: from usual, atypical, and atypical-silent genotypes. It was found that the amino acid sequence of the active-site peptide was identical in all three genotypes. Comparison of the complete sequences of cholinesterase from human serum and acetylcholinesterase from the electric organ of Torpedo californica shows an identity of 53%. Cholinesterase is of interest to the Department of Defense because cholinesterase protects against organophosphate poisons of the type used in chemical warfare. The structural results presented here will serve as the basis for cloning the gene for cholinesterase. The potential uses of large amounts of cholinesterase would be for cleaning up spills of organophosphates and possibly for detoxifying exposed personnel.

1186 (AD-A—196584/7/XAB) Chemical-stockpile disposal program. Community review support study: Aberdeen area. Final report, April-October 1987. (EA Engineering, Science, and Technology, Inc., Sparks, MD (USA)). Oct 1987. 191p. (EA-USA—72A). NTIS, PC A09/MF A01.

The U.S. Department of Defense is required by Public Law 99-145 to destroy the stockpile of lethal chemical agents and munitions stored at eight U.S. Army installations in the continental United States in addition to chemical agents stored at Johnston Island in the Pacific. Public Law 99-145 includes a mandate to destroy all stockpiles by 30 September 1994. This report was produced by EA Engineering, Science and Technology on the behalf of concerned citizens in the area of Aberdeen Proving Ground (APG) where the Army has proposed to build an incinerator to dispose of chemical agent stored at APG. The report addresses areas of concern which the citizens identified and makes a series of recommendations as to how the chemical agent (HD) at APG might be disposed of.

1187 (AERONOMICA-ACTA-A—325-1987) Temperature dependence of ultraviolet absorption cross sections of chlorofluoroethanes. Simon, P.C.; Gillotay, D.; Vanlaethem-Meuree, N.; Wisemberg, J. (Institut d'Aeronomie Spatiale de Belgique, Brussels). 1988. 35p. (ETN—88-92485). NTIS, PC A03/MF A01.

Absorption cross sections of 3 haloethanes (C2F5Cl, C2F4Cl2 (CF2Cl-CF2Cl), and C2F3Cl3 (CF2Cl-CFCl2)) measured between 172 and 250 nm for temperatures from 225 to 295 K, are presented with uncertainties between 2 and 4 percent. They are compared with measurements at room temperature and at only one low temperature (208 K). The largest temperature effects which take place near the absorption threshold can be up to 50 percent for C2F3Cl3, and 70 percent for C2F4Cl2; temperature effect, if any, is too small to be detected in the case of C2F5Cl. Extrapolated values for temperatures of aeronomical interest are presented as well as parametrical formulas which give absorption cross section values for given wavelength and temperature useful in stratospheric modeling calculations. Photodissociation coefficients are presented and their temperature dependence is discussed.

1188 (BNL—41734) Chemically modified polypyrrole. Inagaki, T.; Skotheim, T.A.; Lee, H.S.; Okamoto, Y.; Samuelson, L.; Tripathy, S. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880669—17). NTIS, PC A02/MF A01. Order Number DE89001094/JAW.

From International conference on science and technology of synthetic metals; Santa Fe, NM, USA (26 Jun 1988).

Polypyrrole (PPy) films have been systematically modified with electroactive groups in the β-position to design electrode materials with specific electrochemical and surface active properties. Electrochemical copolymerization of pyrrole and 3-(6-ferrocenyl,6-hydroxyhexyl)pyrrole (P-6-Fc) yields a ferrocene functionalized polypyrrole with a controlled amount to ferrocene functionalization. And also, copolymers of pyrrole and 3-(4-(2,5-dimethoxyphenyl)butyl)pyrrole (P-MP) can be made by electrochemical polymerization and converted to the copolymers containing pH dependent electroactive hydroquinone moieties. Derivatized pyrroles have also been incorporated into Langmuir-Blodgett film structures. The surface pressure-area isotherms of 3-(13-ferrocenyl,13-hydroxytridecy)pyrrole (P-13-Fc) and the mixed monolayer of P-13-Fc and 3-n-hexadecylpyrrole (HDP) are shown. 17 refs., 4 figs.

1189 **(DOE/ER/13821—1) Complex temporal and spatial patterns in nonequilibrium systems: Progress report, December 1, 1987-November 30, 1988.** Swinney, H.L. (Texas Univ., Austin (USA). Dept. of Physics). Sep 1988. Contract FG05-88ER13821. 7p. NTIS, PC A02/MF A01. Order Number DE89001964/JAW.

Dynamical systems methods are being developed and used to characterize nonequilibrium processes and to address outstanding unresolved questions regarding bifurcations and chaos, especially in reaction-diffusion systems. An information-theoretic property, the mutual information, is being examined as a means for detecting and quantifying spatiotemporal chaos. A recent analysis has shown that information on dynamics deduced from noisy data can be used to reduce the noise in those data. These tools from dynamical systems and information theory are being applied to data obtained in laboratory experiments on homogeneous systems and on extended systems. A novel unstirred chemical reactor has been designed for studies of the development and evolution of chemical spatial patterns, and experiments with this reactor have yielded the first sustained chemical spatial patterns in a controlled laboratory environment. These laboratory experiments and numerical and analytic studies of models should provide general insights into spatiotemporal patterns in nonequilibrium systems. 14 refs.

1190 **(INIS-mf—11317) 8th Czechoslovak spectroscopic conference. Abstracts. Section M - molecular spectroscopy.** (Ceskoslovenska Spektroskopicka Spolecnost, Prague). 1988. 170p. (CONF-8806259—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704354/JAW.

From 8. Czechoslovak spectroscopic conference; Ceske Budejovice, Czechoslovakia (19 Jun 1988).

Volume 2 of the conference proceedings contains abstracts of 17 invited papers and 119 poster presentations, devoted to molecular spectroscopy. Abstracts of 2 poster presentations were inputted in INIS, one dealing with organic complexes of /sup 99/Tc, the other with electronic spectra of lanthanide ions. (A.K.).

1191 (INIS-mf—11317, pp 76) **Different routes to /sup 99/Tc organic complexes studied through UV-VIS spectra.** Stella, R.; Ganzerli-Valentini, M.T. (Pavia Univ. (Italy)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704354/JAW. (CONF-8806259—).

From 8. Czechoslovak spectroscopic conference; Ceske Budejovice, Czechoslovakia (19 Jun 1988).

1192 (INIS-mf—11317, pp 78) **Investigation of 4f-electronic spectra of lanthanide ions with β-diketones.** Tishchenko, M.A. (Odesskij Politekhnicheskij Inst. (Ukrainian SSR)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704354/JAW. (CONF-8806259—).

From 8. Czechoslovak spectroscopic conference; Ceske Budejovice, Czechoslovakia (19 Jun 1988).

1193 **(JINR-R—12-87-796) Photochemical synthesis of chromium(5) compound in pentanol for target with hydrogen polarized nuclei.** Bunyatova, Eh.I.; Maloletov, S.M.; Sherstyuk, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; AN Ukrainskoj SSR, Kiev. Inst. Fizicheskoj Khimii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704656/JAW.

Submitted to the journal Zh. Teor. Ehksp. Khim. .

Photochemical processes and reactions in darkness which follow them were investigated under irradiation of ammonium bichromate dissolved in pentanol with He-Cd laser light (λ=441 nm). Exposing the solution to laser light directly in the resonator of the radiospectrometer results in an EPR signal with g=1.973, which is typical of Cr(V) compounds. The produced compounds were investigated by EPR and optical-spectroscopy methods. The reaction kinetics was analysed. The results obtained allow an assumption that the photochemical reaction yields homogeneous Cr(V) compounds. No Cr(III) compounds and other paramagnetic products are detected in the system under investigation. One can expect that the synthesized compounds will effectively work in polarised nuclear targets. 25 refs.; 5 figs.

1194 **(N—88-25327) NASA research program: the roles of fluid motion and other transport phenomena in the morphology of materials. Final report, July 1983-October 1987.** (Princeton Univ., NJ (USA)). May 1988. 208p. (NASA-CR—182801; NAS—1.26:182801). NTIS, PC A10/MF A01.

The influence of transport phenomena on the morphology of crystalline materials was investigated. Two problems were studied: the effects of convection on the crystallization of pure materials. and the crystallization of proteins from solution.

1195 **Tunable far-infrared laser spectroscopy of hydrogen bonds: The K/sub a/ = 0(u)→1(g) rotation—tunneling spectrum of the HCl dimer.** Blake, G.A.; Busarow, K.L.; Cohen, R.C.; Laughlin, K.B.; Lee, Y.T.; Saykally, R.J. (Division of Geological and Planetary Sciences, California Institute of Technology 170-25, Pasadena, California 91125). *Journal of Chemical Physics;* **89**: No. 11, 6577-6587(1 Dec 1988).

The ground state K/sub a/ = 0(u)→1(g) b-type subband of the rotation—tunneling spectrum of the symmetric $^{35}Cl—^{35}Cl$, $^{37}Cl—^{37}Cl$, and the mixed $^{35}Cl—^{37}Cl$ hydrogen chloride dimers have been recorded near 26.3 cm^{-1} with sub-Doppler resolution in a continuous two-dimensional supersonic jet with a tunable far-infrared laser spectrometer. Quadrupole hyperfine structure from the chlorine nuclei has been resolved. From the fitted rotational constants a $(I:^{35}Cl)_2$ center-of-mass separation of 3.81 A is derived for the K/sub a/ = 1(g) levels, while the nuclear quadrupole coupling constants yield a vibrationally averaged angular structure for both tunneling states of approximately 20—25 deg for the hydrogen bonded proton and at least 70—75 deg for the external proton. This nearly orthogonal structure agrees well with that predicted by ab initio theoretical calculations, but the observed splittings and intensity alterations of the lines indicate that the chlorine nuclei are made equivalent by a large amplitude tunneling motion of the HCl monomers. A similar geared internal rotation tunneling motion has been found for the HF dimer, but here the effect is much greater. The ground state tunneling splittings are estimated to lie between 15—18 cm^{-1}, and the selection rules observed indicate that the trans tunneling path dominates the large amplitude motion, as expected, provided the dimer remains planar. From the observed hyperfine constants, we judge the dimer and its associated tunneling motion to be planar to within 10°.

1196 **Studies of chemical reactivity in the condensed phase. IV. Density dependent molecular dynamics simulations of vibrational relaxation in simple liquids.** Brown, J.K.; Harris, C.B.; Tully, J.C. (Department of Chemistry, University of California at Berkeley, Berkeley, California 94720 and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **89**: No. 11, 6687-6696(1 Dec 1988).

Molecular dynamics simulations of the photodissociation/recombination process for iodine in liquid xenon at several densities are reported in this paper. These simulations were performed to aid in the understanding and interpretation of recent picosecond experimental investigations on model chemical reaction systems. From these calculations, it was found that geminate recombination occurs primarily within a few picoseconds at all densities considered. This is in agreement with previous molecular dynamics simulations with significantly smaller systems, and with the current interpretation of experimental results. Simulated iodine ground electronic state vibrational relaxation times range from about 1 ns at the lowest density to approximately 250 ps at the highest density reported here. In addition, the functional form of the decay of the average iodine vibrational energy was observed to be nearly independent of density. This result is discussed in terms of simple gas phase isolated binary collision models. Various force correlation functions projected onto the iodine vibrational coordinate were also examined, and indicate that the iodine molecule significantly perturbs the local solvent environment. These force correlation functions may be helpful when assessing the usefulness of liquid phase theories of vibrational relaxation of highly excited molecules. Finally, the simulation results on iodine vibrational relaxation are compared with the available experimental data. These comparisons indicate that the molecular dynamics calculations overestimate the rate of vibrational relaxation over

the lower third of the iodine ground electronic state potential surface, and that the efficiency of V—TR transfer, relative to V—V transfer, may have been underestimated. The sensitivity of these results to several system parameters are analyzed.

1197 Crossed molecular beam studies of the reactions of methyl radicals with iodoalkanes. Robinson, G.N.; Nathanson, G.M.; Continetti, R.E.; Lee, Y.T. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **89**: No. 11, 6744-6752(1 Dec 1988).

The I atom exchange reactions, $CH_3 + RI \rightarrow CH_3 I + R$[R = CF_3 , $(CH_3)_3$ C], were investigated at a collision energy of ≃13 kcal/mol using the crossed molecular beams technique. The supersonic beam of methyl radicals was formed by pyrolyzing a mixture of ≃1% di-tert-butyl peroxide in helium in a quartz nozzle. A large fraction of the total energy available to the products from these reactions is channeled into relative translation [≃50% for R = $(CH_3)_3$ C and ≃70% for R = CF_3] suggesting that the dominant interaction among the products is repulsive. The CH_3 I product from both reactions was observed to be entirely backward scattered with respect to the incident radical beam indicating that a roughly collinear C—I—C transition state geometry is favored. The present results are compared to those of earlier crossed beam studies of the $CH_3 + IY \rightarrow CH_3 I + Y$(Y = Cl, Br, I) reactions; the differences observed among these reactions are explained with reference to the CH_3 I—Y and CH_3 I—R interaction potentials.

1198 State-resolved ultrafast internal conversion in chromyl chloride. Xie, Y.J.; Kwok, H.S. (Department of Electrical and Computer Engineering, State University of New York at Buffalo, Amherst, New York 14260). *Journal of Chemical Physics;* **89**: No. 11, 6771-6776(1 Dec 1988).

The technique of infrared multiphoton ionization was used to obtain state specific internal conversion rates in $CrO_2 Cl_2$. Using tunable 10 ps dye laser pulses, different vibrational states in the B_1 manifold were excited and the energy relaxation was monitored by an IR ps laser pulse. The relaxation can be characterized by a fast component, which is due to internal conversion to the $^1A_1$ state, and a slow component, which is due to cooling of the vibrationally hot $^1A_1$ ground state. The nonradiative energy transfer rate changes by almost three orders of magnitude for an excess vibrational energy change of merely 550 cm/sup -1/. The possibility of state specific pumping of $^1A_1$ is also pointed out.

1199 Ab initio self-consistent field (SCF) calculations on borane icosahedra with zero, one, or two substituted carbon atoms. Green, T.A.; Switendick, A.C.; Emin, D. (Solid State Theory Division 1151, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **89**: No. 11, 6815-6822(1 Dec 1988).

Restricted Hartree—Fock calculations at the double-zeta level are performed for the closed-shell isoelectronic molecules $B_{12}H$/sup -2//sub 12/, $CB_{11}H^-$/sub 12/ , and 1,12-C_2 B/sub 10/ H/sub 12/ . The geometries are optimized and the vibrational spectra are obtained. The behavior of the molecular orbitals upon carbon substitution is analyzed. The results are compared with the available experimental and theoretical results from the literature. The main features of the electronic structure are correctly described at this level of approximation. The new results can aid in the interpretation of photoemission, infrared absorption, and Raman scattering experiments on these molecules.

1200 Thermochemistry of the plutonium fluorides from electron impact studies. Kleinschmidt, P.D. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **89**: No. 11, 6897-6904(1 Dec 1988).

The ionization potentials of the molecules PuF_5, PuF_4, and PuF_3 have been measured using electron impact ionization. The values are, respectively, 14.5 +- 0.1, 11.8 +- 0.4, and 8.6 +- 0.5 eV. The parent ion PuF^+_6 was not detected. From the ionization potentials and the fragment ion appearance potentials the bond dissociation energies of the molecules $F_5Pu—F$, $F_4Pu—F$, $F_3Pu—F$, and $F_2Pu—F$ have been calculated to be 53 +- 2, 108 +- 12, 113 +- 5, and 141 +- 16 kcal/mol, respectively. Upon comparison with data available on the plutonium fluorides the bond energies of $F_3Pu—F$ and $F_2Pu—F$ are accurate to within the stated uncertainty. The values of the bond energies of $F_5Pu—F$ and $F_4Pu—F$ disagree with the reported enthalpy of formation of PuF_6(s). Analysis of available data indicates that the enthalpy of formation of PuF_6(s) is most likely -484 +- 10 kcal/mol.

1201 Theory of semipermeable vesicles and membranes: An integral-equation approach. I. General formalism and application to a hard-sphere mixture. Zhou, Y.; Stell, G. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794). *Journal of Chemical Physics;* **89**: No. 11, 7010-7019(1 Dec 1988).

An exact integral-equation formalism for a system of a binary hard-sphere mixture interacting with a spherical semipermeable vesicle (SPV) and plane semipermeable membrane (SPM) is derived by using the Ornstein—Zernike (OZ)= equation with appropriate closures. The Percus—Yevick (PY) closure or the hypernetted chain (HNC) closure, in which the bulk correlation is obtained by the PY approximation, are considered as examples. We refer to these as the PY/PY and HNC/PY approximations, respectively. The mixture contains solvent particles, which are permeable to the membrane, and solute particles ("protein" or "polymer" particles), which can not pass through the membrane. We develop an exact general formalism for this problem and as an illustration of its use give quantative results for solvent and solute particles modeled as hard spheres of different diameters. An analytical expression for the density ratio in the PY/PY and HNC/PY approximations between two sides of a plane SPM is obtained. Results obtained from these expressions agree very well with results obtained by equating chemical potentials in the region of interest. It turns out that the protein—membrane direct correlation function can be given by a simple analytic expression for the limit of a point solvent in the PY/PY approximation. The osmotic pressure and density profiles for the system containing an ideal spherical SPV or plane SPM in the PY/PY approximation are evaluated. Extension to the nonlocal density-functional closures previously introduced by Blum and Stell is discussed. Finally, we note that certain impenetrable-wall problems previously considered elsewhere can be regarded as semipermeable membrane problems treated via McMillan—Mayer formalism in the continuum—solvent approximation.

1202 Transient vibrational spectroscopy by flash photolysis stimulated emission pumping: 3νZ of singlet methylene. Xie, W.; Ritter, A.; Harkin, C.; Kasturi, K.; Dai, H. (Department of Chemistry, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Journal of Chemical Physics;* **89**: No. 11, 7033-7035(1 Dec 1988).

A vibration—rotation spectroscopic method based on stimulated emission pumping has been developed for transient molecules generated by flash photolysis. This method may be generally applicable to radicals with electronic excited states accessible by visible or UV laser pulses. This first demonstration on the bending $\nu_2 = 3$ level of a-italic-tilde $^1A_1$ CH_2 generated a vibrational term value of 3950.45(7) cm^{-1} and the rotational constants A = 25.665(40), B = 11.470(7), and C = 6.7140(61) cm^{-1}. These constants indicate that the $3\nu_2$ level is well below the bending-potential barrier. Perturbations of several rotational levels by the triplet state are identified. In addition, and most interestingly, abnormally intense ΔK/sub a/ = 3 transitions were observed in the a-italic-tildeleft-arrowb-italic-tilde 2/sup 16/$_3$ band.

1203 Process for producing furan from furfural aldehyde. Diebold, J.P.; Evans, R.J. (to Dept. of Energy, Washington, DC). US Patent 4,764,627. 16 Aug 1988. Filed date 6 Apr 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A process is described for producing furans and derivatives thereof comprising generating furfural vapors, passing the vapors over a zeolite catalyst at a WHSV ratio of about 18-38 in an acidic environment, and at a temperature and for a residence time effective to decarbonylate the furfural to the furans and derivatives thereof, and separating the resultant furan and furan derivative vapors.

1204 **(N—88-25285) Computer simulation of uphill diffusion in ternary ionic system.** Yamagishi, T.; Fujii, K.; Kitsutaka, S. Translated from *Yogyo Kyokai Shi ;* No. 94, 1206-1212(Jun 1988). 16p. (NASA-TT—20194; NAS—1.77:20194). NTIS, PC A03/MF A01.

In mutli-component ionic diffusion systems, uphill diffusion is frequently observed. The conditions for the development of uphill diffusion were investigated by computerized simulation of ion exchange between a glass containing two cations (A,B) and a molten salt containing the third cation (C). The following conclusions were obtained. The uphill diffusion of B ion is observed when D sub A is greater than D sub B is greater than D sub C or D sub A is greater than D sub C is greater than D sub B, if all diffusion coefficients of D are independent of concentration. This uphill diffusion behavior is affected by the molar ratio of A to B in a mother glass. In the simulated ion exchange systems that were investigated, the uphill diffusion was prominent when the mother fraction of B ion is around 0.25. The concentration dependence of D does influence the distribution of ions, however, the relationship between three diffusion coefficients is a more important condition for the development for uphill diffusion. Ion exchange experiments in (Na,Rb) glass/(K) salt and (Na, K) glass/(Tl) salt systems were performed to confirm the results of the simulation. The uphill diffusion of Rb and K ions was observed as predicted by the simulation. The diffusion behavior of ions in glass during the ion exchanging process for the fabrication of gradient index lens was also investigated by computerized simulation. The progression of ion concentration profiles during this ion exchange process, especially the development of the uphill diffusion of Tl ions in the initial stage of this process, was well reproduced.

1205 **(N—88-26483) Refractory materials of zirconate. Part 2. Synthesis and some properties of strontium zirconate, calcium zirconate and barium zirconate.** Okubo, T.; Yonemochi, O.; Nakamura, K.; Maeda, M. (National Aeronautics and Space Administration, Washington, DC (USA)). Jun 1988. Translated from Nagoya Kogyo Gijutsu Shikensho Hohoku (Japan), v. 24, no. 10, 271-277(1975). (NASA-TT—20186; NAS—1.77:20186). 17p. NTIS, PC A03/MF A01.

Chemical compounds $SrZrO_3$, $CaZrO_3$, and $BaZrO_3$ were synthesized by solid reaction and arc fusion, and their properties examined. Results were as follows: (1) in the synthesis of $CaZrO_3$ by solid reaction, ZrO_2 solid solution with cubic form was produced, which then changed into $CaZrO_3$; (2) the $BaZrO_3$ was a cubic form and did not show any transformation, while $SrZrO_3$ and $CaZrO_3$ with an orthorhombic form transformed to a cubic form at high temperature; and (3) the solubility of $BaZrO_3$ in acid and its vaporization rate at a high temperature were greater than those of Ca and Sn zirconates.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 122, 685, 757, 1188

4005 Photochemistry

REFER ALSO TO CITATION(S) 1196, 1213, 2103

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 242, 403, 1061, 1914, 1915

1206 (ACIESP—60-Vol.1, pp 3) **Radiolysis of high temperature aqueous systems.** Ishigure, K.; Katsumura, Y.; Shiraishi, H. (Tokyo Univ. (Japan). Faculty of Engineering). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 130, 629, 1613, 1875

1207 **(JINR-R—6-87-879) Simple method for gallium 67 high-temperature separation from massive germanium target.** Novgorodov, A.F.; Zelinski, A.; Kolachkovski, A. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704646/JAW.

Submitted to the journal Radiokhimiya.

A method for quantitative Ga-67 separation into a gaseous phase from irradiated high-purity germanium its mass being 10-15 g is presented. Irradiation was conducted in the U-240 cyclotron (NRI of the Ukrainian Academy of Sciences) and the JINR phasotron by protons with 65 and 650 MeV energy respectively. The method consists in keeping the irradiated Ge melt at 1373+-10 K in the atmosphere of hydrofluoric acid (P/sub HF/ ~ P/sub H2/O) vapours under their decreased pressure (~ 1.3 Pa) and in subsequent distribution of volatile gallium compounds in a thermochromatographic column. It is indicated that to increase G-67 yield and reduce G-72 content in a product it is necessary to apply germanium enriched with light isotopes (A=70 and 72). 24 refs.; 3 figs.; 2 tabs.

1208 **(NAS-NS—3064) Radiochemistry of astatine.** Ruth, T.J.; Dombsky, M.; D'Auria, J.M.; Ward, T.E. (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). [1988]. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88015386/JAW.

This monograph is a review of the literature through 1987 and covers the methods of producing the radioisotopes of astatine and the inorganic, nuclear, and organic chemistry of astatine. The discussion is limited to chemical and physical chemical properties of astatine. The monograph, after the introduction, is divided into chapters titled: production methods, nuclear spectroscopy, chemistry of astatine, separation and isolation (dry and wet), and selected procedures. 209 refs., 15 figs., 7 tabs. (DLC)

1209 **(RCM—00988) Chemical behaviour of Np, Pu and Am in aquatic solutions. Hydrolysis, carbonate complexation, {alpha}-radiolysis, colloid generation, humic substance characterization and speciation. Final report.** Kim, J.I.; Buckau, G.; Bueppelmann, K.; Klenze, R.; Lierse, C.; Stadler, S. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). May 1988. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755193/JAW.

The chemical behaviour of Np, Am and Pu has been studied in aquatic systems of various ionic strength and NaCl concentrations as well as in natural groundwaters. Basic chemical reactions investigated are hydrolysis reaction of Np(V), Pu(IV) and Am(III), carbonate complexation of Pu(IV) and Am(III), and redox reaction of Pu and Am induced by {alpha}-radiolysis in brine solutions. The {alpha}-induced radiolysis reactions in NaCl solutions are carefully evaluated. The generation of real-colloids of Am(III) and Pu(IV) and the generation of Am(III)-pseudo-colloids through sorption of Am/sup 3+/ on groundwater-colloids have been also investigated. The natural groundwater-colloids and humic substances, being present in Gorleben groundwaters, are characterized systematically in order to facilate a better understanding of colloid generation in a given groundwater. Transuranium ions in solution have been speciated either by UV-VIS spectroscopy for relatively high concentrations or by Laser-induced photoacoustic spectroscopy (LPAS) for sub-{mu}mol concentrations.

1210 **(RCM—01088) Chemical behaviour of plutonium in aqueous chloride solutions.** Bueppelmann, K.; Kim, J.I. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1988. 156p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755194/JAW.

The chemical behaviour of Plutonium has been investigated in concentrated NaCl solutions in the neutral pH range. The {alpha}-radiation induced radiolysis reactions oxidize the Cl/sup -/-ion to Cl/sub 2/, HClO, ClO/sup -/ and other species, which produce a strongly oxidizing medium. Under these conditions the Pu ions of lower oxidation states are readily oxidized to Pu(VI), which then undergo depending on the pH of the solution, various chemical reactions to produce PuO/sub 2/Cl/sub n/, PuO/sub 2/(ClO)/sub m/ or PuO/sub 2/(OH)/sub x/ species. In addition to primary radiolysis reactions taking place in NaCl solutions, the reactions leading to the PuO/sub 2/(Cl)/sub n/ and PuO/sub 2/(ClO)/sub m/ species have been characterized and quantified systematically by spectroscopic and thermodynamic evaluation. The redox and complexation reactions of Pu ions under varying NaCl concentration, specific {alpha}-activity and pH are discussed.

1211 **(RCM—01188) Chemical behaviour of americium in natural aquatic solutions: Hydrolysis, radiolysis and redox reactions.** Stadler, S.; Kim, J.I. (Technische Univ. Muenchen, Garching (Germany, F.R.). Lehrstuhl fuer Radiochemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1988. 148p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755195/JAW.

Hydrolysis and redox reactions of the Am(III) and Am(V) ions have been investigated in NaClO/sub 4/ and NaCl solutions as well as in natural saline groundwaters. The hydrolysis constants of Am(OH)/sub n//sup 3-n/ species and the solubility product of Am(OH)/sub 3/(s) have been determined in 0.1 M NaClO/sub 4/, 0.1 M NaCl and 0.6 M NaCl solutions. As observed in concentrated NaCl solutions (> 3 M), the {alpha}-radiation induces the radiolytic oxidation of the Cl/sup -/-ion to produce Cl/sub 2/, HClO, ClO/sup -/ and other oxidized species, which result in a strongly oxidizing medium. Consequently Am(III) is oxidized to Am(V). Under these conditions the hydrolysis constants of AmO/sub 2/(OH)/sub n//sup 1-n/ species and the solubility product are also determined. The {alpha}-radiation induced radiolysis reactions in NaCl solution and the subsequent oxidation reaction of Am(III) have been systematically investigated by varying pH, NaCl concentration and specific {alpha}-activity. Also included in the investigation are a few selected groundwaters of relatively high salinity from the Gorleben aquifer systems.

1212 **Crystal structures of $(MeC_5H_4)_3M(L)$ (M = uranium or cerium; L = quinuclidine or $P(OCH_2)_3CEt$). Evidence for uranium to phosphorus π-back-bonding.** Brennan, J.G.; Stults, S.D.; Andersen, R.A.; Zalkin, A. (Lawrence Berkeley Lab., CA (USA)). *Organometallics;* 7: No. 6, 1329-1334(Jun 1988). Contract AC03-76SF00098.

The synthesis and X-ray crystal structure of $(MeC_5H_4)_3M(L)$, where M is Ce or U and L is $N(CH_2CH_2)_3CH$ or $P(OCH_2)_3CEt$, are described. Crystals of $(MeC_5H_4)_3U[N(CH_2CH_2)_3CH]$ and $(MeC_5H_4)_3Ce[N(CH_2CH_2)_3CH]$ are triclinic of space group P anti 1 with Z = 2. for the uranium complex, a = 10.604 (4) A, b = 13.552 (6) A, c = 8.333 (4) A, α = 100.20 (4)°, β = 74.78 (4)°, and γ = 104.13 (4)° at 23°C; the calculated density is 1.751 g/cm³. For the cerium compound, a = 10.609 (4) A, b = 13.586 (5) A, c = 8.348 (5) A, α = 100.15 (4)°, β = 74.75 (4)°, and γ = 104.01 (3)° at 23°C; the calculated density is 1.451 g/cm³. The uranium(III) and cerium(III) atoms are each bonded to three cyclopentadienyl rings; the average U-C and Ce-C distances are 2.82 +/- 0.03 and 2.85 +/- 0.03 A, respectively. The U-N and Ce-N distances are 2.764 (4) and 2.789 (3) A, respectively. Crystals of $(MeC_5H_4)_3U[P(OCH_2)_3CEt]$ and $(MeC_5H_4)_3Ce[P(OCH_2)_3CEt]$ are orthorhombic of space group $P2_12_12_1$ with Z = 4. The structure of the two isomorphous complexes were determined by single-crystal X-ray diffraction methods. For the uranium complex, a = 13.122 (5) A, b = 16.363 (5) A, c = 10.922 (4) A at 23°C; the calculated density is 1.806 g/cm³. For the cerium complex, a = 13.163 (7) A, b = 16.443 (7) A, and c = 10.976 (4) A at 23°C; the calculated density is 1.509 g/cm³. The metal atom is tetrahedrally bound to the three cyclopentadienyl rings and a phosphorus atom. The U-P and Ce-P distances are 2.988 (6) and 3.086 (3) A, respectively; the average U-C and Ce C distances are 2.80 +/- 0.05 and 2.82 +/- 0.03 A, respectively.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 335, 336, 337, 642, 1171, 1197, 1485, 1693

1213 (BNL—52069, pp 69-72) **High resolution kinetic energy distributions via doppler shift measurements.** Wittig, C. (Univ. of Southern California, Los Angeles (USA)). 1986. NTIS, PC A13/MF A01. Order Number DE87009460/JAW. (CONF-8605258—).

From 8. combustion research contractors' conference; Airlie, VA, USA (28 May 1986).

In fragmentation processes of the form AB → A + B, the excess energy is manifest as product translational and internal excitation. Thus, for cases in which a monoenergetic ensemble of excited AB molecules dissociates under collision-free conditions, knowledge of the center-of-mass (c.m.) kinetic energy distribution automatically gives the internal energy distribution for the combined fragments. For cases where it is certain that one of the products is in a specific state (e.g. the ground state), the internal energy distribution of the other fragment is determined uniquely. In this way, it is possible to obtain this information for species whose internal state distributions are difficult or impossible to measure directly. For neutral fragments, both molecular beam and sub-Doppler resolution optical techniques have been used to determine c.m kinetic energy distributions and the corresponding fragment internal state distributions. The molecular beam techniques are now sufficiently refined that vibrational and rotational structure are discernible under optimum conditions, and for a particular reaction, increased kinetic energy resolution results in more detailed knowledge of the dynamics involved, with the degree to which one can resolve such distributions depending on the molecular system as well as the apparatus.

1214 **(LA-UR—88-2906) Modeling two-dimensional detonations with detonation shock dynamics.** Bdzil, J.B.; Stewart, D.S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 29p. (CONF-8805194—2). NTIS, PC A03/MF A01. Order Number DE89000383/JAW.

From 6. Army conference on applied mathematics and computing; Boulder, CO, USA (31 May 1988).

In any explosive device, the chemical reaction of the explosive takes place in a thin zone just behind the shock front. The finite size of the reaction zone is responsible for: the pressure generated by the explosive being less near the boundaries, for the detonation velocity being lower near a boundary than away from it, and for the detonation velocity being lower for a divergent wave than for a plane wave. In computer models that are used for engineering design calculations, the simplest treatment of the explosive reaction zone is to ignore it completely. Most explosive modeling is still done this way. The neglected effects are small when the reaction zone is very much smaller than the explosive's physical dimensions. When the ratio of the explosive's detonation reaction-zone length to a representative system dimension is of the order of 1/100, neglecting the reaction zone is not adequate. An obvious solution is to model the reaction zone in full detail. At present, there is not sufficient computer power to do so economically. Recently we have developed an alternative to this standard approach. By transforming the governing equations to the proper intrinsic-coordinate frame, we have simplified the analysis of the two-dimensional reaction-zone problem. When the radius of curvature of the detonation shock is large compared to the reaction-zone length, the calculation of the two-dimensional reaction zone can be reduced to a sequence of one-dimensional problems. 9 refs., 5 figs.

1215 **(N—88-25497) Development of a computerized analysis for solid propellant combustion instability with turbulence. Semiannual report.** Chung, T.J.; Park, O.Y. (Alabama Univ., Huntsville (USA)). May 1988. 49p. (NASA-CR—182351; NAS—1.26:182351). NTIS, PC A03/MF A01.

A multi-dimensional numerical model has been developed for the unsteady state oscillatory combustion of solid propellants subject to acoustic pressure disturbances. Including the gas phase unsteady effects, the assumption of uniform pressure across the

flame zone, which has been conventionally used, is relaxed so that a higher frequency response in the long flame of a double-base propellant can be calculated. The formulation is based on a premixed, laminar flame with a one-step overall chemical reaction and the Arrhenius law of decomposition with no condensed phase reaction. In a given geometry, the Galerkin finite element solution shows the strong resonance and damping effect at the lower frequencies, similar to the result of Denison and Baum. Extended studies deal with the higher frequency region where the pressure varies in the flame thickness. The nonlinear system behavior is investigated by carrying out the second order expansion in wave amplitude when the acoustic pressure oscillations are finite in amplitude. Offset in the burning rate shows a negative sign in the whole frequency region considered, and it verifies the experimental results of Price. Finally, the velocity coupling in the two-dimensional model is discussed.

1216 **(N—88-26255) On-line measurement of heat of combustion. Final report, period ended 30 April 1988.** Chaturvedi, S.K.; Chegini, H. (Old Dominion Univ., Norfolk, VA (USA)). Jul 1988. 18p. (NASA-CR—183076; NAS—1.26:183076). NTIS, PC A03/MF A01.

An experimental method for an on-line measurement of heat of combustion of a gaseous hydrocarbon fuel mixture of unknown composition is developed. It involves combustion of a test gas with a known quantity of air to achieve a predetermined oxygen concentration level in the combustion products. This is accomplished by a feedback controller which maintains the gas volumetric flow rate at a level consistent with the desired oxygen concentration in the products. The heat of combustion is determined from a known correlation with the gas volumetric flow rate. An on-line microcomputer accesses the gas volumetric flow data, and displays the heat of combustion values at desired time intervals.

1217 **(N—88-26539) Reducing adhesion and agglomeration within a cloud of combustible particles.** Ross, H.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1988. 42p. (NASA-TM—100902; E—4082; NAS—1.15:100902). NTIS, PC A03/MF A01.

The study of combustible particle clouds inside flame tubes is of fundamental scientific interest as well as a practical concern. Only the suspended concentration is important to the combustion process, so that assurances must be provided that a minimum of particles adheres to the tube wall. This paper demonstrates experimentally the ability to minimize adhesion and agglomeration of acoustically-mixed lycopodium particles within a 5-cm diameter lexan flame tube. The area density of particles (ADP) adhering to the wall of bare lexan tubes was measured at greater than 100 particles/sq mm. The nature of adhesion was found to be clearly electrostatic, with the ADP level aggravated by increased mixing time, vigor, and the concentration of particles. Increases in the conductivity of the air and the tube wall did not affect ADP levels substantially. However, the observed adhesion was reduced to less than 10 p/sq mm when the air was ionized by use of an alpha emitter mounted on the inner walls of the flame tube.

1218 **(NEI-SE—19) Research on combustion technology. Energy research 1987-1990.** (Statens Energiverk, Stockholm (Sweden)). 20 Oct 1987. 26p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755053/JAW.

An overview is given of the R and D areas in combustion technology that is going to get financial support from the Swedish National Energy Administration during the three year period July 1987 - June 1990. The environmentally oriented combustion research will get high priority, especially projects of long term character. Other areas of interest are: catalytic phenomena, fluidized beds, pulverized fuel combustion small-scale combustion, and flue gas condensation. (L.E.).

1219 **(NLVF/S—699) Combustion properties for pyrolytic gas from wood under various conditions. Final report.** Berg, H.; Olsen, T:. (A/S Joetul, Oslo (Norway)). (Norges Landbruksvitenskapelige Forskningsraad, Oslo). Feb 1987. 13p. (In Norwegian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755062/JAW.

The report deals with an investigation done on the combustion properties of pyrolytic gas from wood under various combustion conditions. The combustion time and temperature are presented for the satisfactory combustion processes and the sensors used for the mapping of parameters, are given. In addition, the costs of sensors are considered in order to succeed in finding a system to be used in smaller wood furnaces.

1220 **(N—88-25502) Measurement of the radiative properties of gas and oil flames.** Tietze, H.; Guenther, R. (National Aeronautics and Space Administration, Washington, DC (USA)). Jun 1988. Translated from Messung der Strahlungseigenschaften von Gas- und Oelflammen, Gas Waerme International (Federal Republic of Germany), v. 25, no. 1-12, 563-570(Nov-Dec 1976). (NASA-TT—20299; NAS—1.77:20299). 24p. NTIS, PC A03/MF A01.

Radiation and concentration measurements were carried out with different flame lengths in order to predict the interaction between furnace and flame in respect of heat emission with combustion spaces of varying dimensions. Fuel, heat throughput, burner momentum, air ratio and, in some cases, the momentum of the atomizing air were varied. Evaluation of the instrument readings will furnish information about the local distribution of the degree of emission and temperature under different input conditions and give an idea of the variations to be expected when changing over from a small combustion space to a larger one. The paper deals mainly with the radiation and temperature measuring methods used and presents a description of the test setup. The results obtained are outlined.

1221 **Dual Stokes cars measurements in supersonic combusting flow.** Jarrett, O. Jr.; Antcliff, R.R.; Chitsomboon, T.; Diskin, G.S.; Cutler, A.D. Hampton, VA; National Aeronautics and Space Administration (1987). vp. NTIS, PC A17/MF A01.

Coherent antiStokes Raman spectroscopy (CARS) was used to make simultaneous measurements of temperature, nitrogen and oxygen density in a reacting supersonic flow. A supersonic burner (SSB) was designed to provide supersonic flow in which combustion can be studied in the laboratory. Measurements made with the CARS system will be used for validation of computational fluid dynamic (CFD) codes. Preliminary results of the CFD calculations are presented.

1222 **Development of a generic combustion stability code for liquid propellant rocket engines.** Fang, J.J.; Jones, Y.T. Sacramento, CA; Aerojet TechSystems Company (1987). vp. NTIS, PC A17/MF A01.

The mathematical framework for a combustion stability analysis code is outlined. The goal for the code is to be general enough in problem treatment so that its validity and accuracy extend over a wide range of problem applications and that it lends the convenience for any future model improvement if necessary. An approach for modeling the combustion dynamics is devised to meet both requirements. An open-loop numerical procedure is also developed to mechanistically model various combustion processes for determining the stability parameters.

1223 **Numerical grid generation and flow simulation in SSME thrust chamber.** Gross, K.W.; Daley, P.L.; Przekwas, A.J. Huntsville, AL; National Aeronautics and Space Administration (1987). vp. NTIS, PC A17/MF A01.

The development of liquid and solid rocket engines for future space projects demands a detailed optimization process for highly efficient performance and cost reasons. Also, testing of full size engines may not be feasible when the large size requires test facilities which are cost prohibitive or if vacuum operation cannot be acquired. For such situations only scaling from small test scale measurements or accurate analytical predictions will provide the performance prior to actually flying the mission. A rigorous approach for simulating the combustion processes in liquid rocket engines by employing a direct solution of Navier-Stokes equations within the entire volume of the thrust chambers is presented. This method is illustrated in the solution of reactive flow in the Space Shuttle Main Engine (SSME) thrust chamber. The objective is to

review recent improvements in the mathematical model and to present the grid generation methodology suitable for rocket thrust chamber geometries.

1224 **Liquid engine jet atomization Workshop report.** Gross, K.W. Huntsville, AL; National Aeronautics and Space Administration (1987). vp. (CONF-8709365—). NTIS, PC A17/MF A01.

From Liquid engine jet atomization workshop; Huntsville, AL, USA (16 Sep 1987).

The workshop was oriented to disclose information and unsettled problems in understanding the fundamental physical mechanism of the droplet formation process. Based on presentation and discussion of results, recommendations were made which should lead to associated future activities. To accomplish this task, existing observations and experiments, contributing to the basic knowledge, providing data for analytical concept verification, and forming a basis for empirical correlations were solicited. Advanced analytical modeling methods or results from specific studies were requested as well as the experience and advice from injector designers. All effort is directed to advance current analytical techniques, simulating the flow behavior downstream of the injection elements in a liquid rocket combustion chamber. Such a tool can be used to optimize injector designs with respect to short length weight savings, wall material protection, or large heat energy transport to a regenerative cooling fluid, while simultaneously achieving the maximum specific impulse in performance. The liquid atomization process also forms a sound basis for combustion instability analysis.

42 ENGINEERING

REFER ALSO TO CITATION(S) 2689

1225 **(UCID—21499) A pulse-shape discriminator for a portable fast-neutron spectrometer.** Thorngate, J.H. (Lawrence Livermore National Lab., CA (USA)). 22 Sep 1988. Contract W-7405-ENG-48. 11p. NTIS, PC A03/MF A01. Order Number DE89001859/JAW.

In an organic material, neutrons produce recoil protons, and gamma rays produce Compton recoil electrons. For some organic scintillators, the signals produced by protons decay differently from those produced by electrons. This allows the signals to be separated with an electronic circuit called a pulse-shape discriminator (PSD). We have designed a compact PSD circuit that is suitable for use in a portable instrument. It consumes one watt of power, is compact, and has the capability to process pulses that vary in size over a factor of 200. 5 figs.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 103, 212, 229, 246, 288, 1092, 1265, 1518, 1531, 1613, 1617, 1882, 1990, 2002, 2253, 2462, 2469, 2594, 2639, 2644

1226 **(AD-A—196266/1/XAB) Input manual for the Army Unit Resiliency Analysis (AURA) methodology: 1988 update. Final report, 1984-March 1988.** Klopcic, J.T. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). May 1988. 107p. (BRL-TR—2914). NTIS, PC A06/MF A01.

Since its inception in 1978, the Army Unit Resilience Analysis (AURA) methodology has been applied to broad spectrum of unit-level survivability/sustainability problems by an increasing number of analysts in the U.S. and abroad. The methodology has continued to grow to respond to special needs that have arisen in the many applications which resulted in the publication of an AURA user's manual to update and standardize runstreams between users. The first such a manual was published in 1985(AD-A159 327). Since the publication of the first manual, several options have been added, including a major extension to the functional structure to include the CREW option. The purpose of this report is quite limited, viz. to update the compendium of input commands and formats for the AURA program. Only a brief description is given with each of the 60 commands listed. Commands are grouped by function: Execution, Names, Asset descriptors, Deployment Weapons and Weapon effects, Individual tasks, Unit functions and Program controls. In addition, sections are included on general information and appendices containing lethality file information and on AURA overview.

1227 **(AD-A—196560/7/XAB) Required operational capability (ROC) for NBC protective covers.** (Army Training and Doctrine Command, Fort Monroe, VA (USA)). 26 May 1988. 9p. NTIS, PC A02/MF A01.

A capability is needed to protect supplies and equipment from liquid chemical-agent contamination, radiological fallout, and biological-agent contamination. By providing a barrier between the articles and possible NBC agent contamination, the Army's burden for decontamination will be eased. The NBC-PC will also reduce the spread of contamination, help prevent casualties, and make supplies and equipment more readily available in an NBC environment. The NBC-PC will allow units at all levels to better implement current doctrine on contamination avoidance with minimal logistical impact.

1228 **(CAPE—3008) Final design report for the Prototypical Consolidation Demonstration Project, Phase 2: Drawings (Engineering Materials).** (Nutech Engineers, Inc., San Jose, CA (USA)). 1987. Contract AC07-86ID12647. 53 H. Order Number TI88015020/JAW.

Includes 53 sheets of 48x reduction microfiche; These drawings accompany Report No. DOE/ID/12647--2-Vols.1-6.

This report documents NUTECH's final design of a dry, spent fuel rod consolidation system. The scope of Phase 2 of the PCDP has resulted in a final design, plus all of the engineering documentation required to demonstrate that the specified design requirements for the system are satisfied by that design. This document provides engineering drawings regarding equipment design. Reference DOE/ID/12647--2-Vols.1-6.

1229 **(CAPE—3009) Final design report for the Prototypical Consolidation Demonstration Project, Phase 2: Drawings (Engineering Materials).** (Nutech Engineers, Inc., San Jose, CA (USA)). 1987. Contract AC07-86ID12647. 16 OSTI, PO Bx 62, Oak Ridge, TN 37831- Available from OSTI. Order Number DE88015021/JAW.

Includes 16 sheets of 48x reduction microfiche; These drawings accompany Report No. DOE/ID/12647--2-Vols.1-6.

This report documents NUTECH's final design of a dry, spent fuel rod consolidation system. The scope of Phase 2 of the PCDP has resulted in a final design, plus all of the engineering documentation required to demonstrate that the specified design requirements for the system are satisfied by that design. This document contains engineering drawings pertaining to equipment design. Reference DOE/ID/12647--2-Vols.1-6.

1230 **(CAPE—3010) Final design report for the Prototypical Consolidation Demonstration Project, Phase 2: Drawings (Engineering Materials).** (Nutech Engineers, Inc., San Jose, CA (USA)). 1987. Contract AC07-86ID12647. 42 H. Order Number TI88015023/JAW.

Includes 42 sheets of 48x reduction microfiche; These drawings accompany Report No. DOE/ID/12647--2-Vols.1-6.

This report documents NUTECH's final design of a dry, spent fuel rod consolidation system. The scope of Phase 2 of the PCDP has resulted in a final design, plus all of the engineering documentation required to demonstrate that the specified design requirements for the system are satisfied by that design. This document contains engineering drawings pertaining to equipment design. Reference DOE/ID/12647--2-Vols.1-6.

1231 **(CAPE—3011) Final design report for the Prototypical Consolidation Demonstration Project, Phase 2: Drawings (Engineering Materials).** (Nutech Engineers, Inc., San Jose, CA (USA)). 1987. Contract AC07-86ID12647. 76 H. Order Number TI88015022/JAW.

Includes 76 sheets of 48x reduction microfiche; These drawings accompany Report No. DOE/ID/12647--2-Vols.1-6.

This report documents NUTECH's final design of a dry, spent fuel rod consolidation system. The scope of Phase 2 of the

PCDP has resulted in a final design, plus all of the engineering documentation required to demonstrate that the specified design requirements for the system are satisfied by that design. This document contains engineering drawings pertaining to equipment design. Reference DOE/ID/12647--2-Vols.1-6.

1232 **(CAPE—3012) Final design report for the Prototypical Consolidation Demonstration Project, Phase 2: Drawings (Engineering Materials).** (Nutech Engineers, Inc., San Jose, CA (USA)). 1987. Contract AC07-86ID12647. 24 H. Order Number TI88015025/JAW.

Includes 24 sheets of 48x reduction microfiche; These drawings accompany Report No. DOE/ID/12647--2-Vols.1-6.

This report documents NUTECH's final design of a dry, spent fuel rod consolidation system. The scope of Phase 2 of the PCDP has resulted in a final design, plus all of the engineering documentation required to demonstrate that the specified design requirements for the system are satisfied by that design. This document provides engineering drawings pertaining to equipment design. Reference DOE/ID/12647--2-Vols.1-6.

1233 **(CONF-881123—2) Flow speed measurement and rheometry by pulsed neutron activation.** Porges, K.G.A.; Cox, S.A.; Herzenberg, C.; Kampschoer, C. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 5p. NTIS, PC A02. Order Number DE89000525/JAW.

From 3. international symposium on liquid-solid flows (WAM); Chicago, IL, USA (28 Nov 1988).

Pulsed Neutron Activation (PNA) is a means of non-invasive flow velocity measurement based on tagging the flowing medium with a short-lived radioactivity. Previous work with salt or dye-tagging showed poor accuracy in turbulent and failed in laminar flow when conventional data processing was used. However, use of a data acquisition and processing scheme that is based on tag dispersion modelling can produce absolute values over a wide range of flow speeds and regimes with high accuracy. For non-Newtonian/laminar flow, rheological information can also be obtained. The inherently non-intrusive nature of PNA tagging makes this scheme available for slurry measurements. The performance of PNA in slurry flow at up to 60 percent solid content was compared to full-flow diversion and weighing. Errors ranged from less than 0.2% at high Reynolds' numbers to about 2% for paste flow. Rheological parameters (yield shear stress or flow behaviour index) could be determined with an accuracy that compared to that of a spindle viscometer with grab-samples. The PNA scheme thus offers a unique means of studying slurry flow in a dedicated laboratory facility, or of providing calibration for other flowmeters in an industrial plant through temporary installation by a team of expert consultants. 27 refs., 8 figs.

1234 **(CONF-881140—4) Telerobotic vehicle for evaluating remote battlefield support operations.** Richardson, B.S.; Armstrong, G.A.; Manges, W.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014559/JAW.

From 2. international symposium on robotics and manufacturing research, education and applications; Albuquerque, NM, USA (16 Nov 1988).

A general purpose mobile telerobotic testbed is being developed for studying and evaluating the application of telerobotic technology in battlefield support operations. The system provides teleoperation capability to address the functional feasibility of mobile telerobotics technology with an emphasis on soldier machine interface issues.

1235 **(CONF-881140—5) Navigation and learning experiments by an autonomous robot.** de Saussure, G.; Weisbin, C.R.; Spelt, P.F. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88014546/JAW.

From 2. international symposium on robotics and manufacturing research, education and applications; Albuquerque, NM, USA (16 Nov 1988).

Developing an autonomous mobile robot capable of navigation, surveillance and manipulation in complex and dynamic environments is a key research activity at CESAR, Oak Ridge National Laboratory's Center for Engineering Systems Advanced Research. The latest series of completed experiments was performed using the autonomous mobile robot HERMIES-IIB (Hostile Environment Robotic Machine Intelligence Experiment Series II-B). The next section describes HERMIES-IIB and some of its major components required for autonomous operation in unstructured, dynamic environments. Section 3 outlines some ongoing research in autonomous navigation. Section 4 discusses our newest research in machine learning concepts. Section 5 describes a successful experiment in which the robot is placed in an arbitrary initial location without any prior specification of the content of its environment, successively discovers and navigates around stationary or moving obstacles, picks up and moves small obstacles, searches for a control panel and performs a learned sequence of manipulations on the panel devices. The last section outlines some future directions of the program.

1236 **(DOE/ER/13433—3) Analytical and experimental studies for thermal plasma processing of materials: Progress report for 3rd year.** (Minnesota Univ., Minneapolis (USA)). 1988. Contract FG02-85ER13433. 4p. NTIS, PC A02/MF A01. Order Number DE89001784/JAW.

This paper discusses: New triple torch plasma reactor; Synthesis experiments in a DC plasma jet reactor; Enthalpy probe measurements; and Modeling of plasma jets with vortex flow. (LSP)

1237 (ESA-SP—280, pp 221-231) **Computer aided remote control: a general concept for intervention in the nuclear, underwater, and space domains.** Andre, G.; Fournier, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France)). Mar 1988. (In French). NTIS, PC A15/MF A01. (ETN—88-92782; CONF-8711239—).

From Colloquium on space and sea; Marseille, France (24 Nov 1987).

Research and development in remote operation robotics are reviewed, especially flexibility, adaptability, autonomy, and system observability. An architecture for computer aided remote operation is presented. Problems associated with the main subsystems are considered: generalized bilateral control; information feedback; programming; and supervision. An integrated test site and ergonomic factors in its design are described. Applications to space, oceanographic, and nuclear domains are suggested.

1238 **(JAERI-M—88-105) ALBEDO: a multi-layer albedo computer code for nuclear criticality safety analysis.** Naito, Yoshitaka; Osada, Kazuo; Sakai, Tomohiro. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jun 1988. 23p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755213/JAW.

A computer code ALBEDO has been developed to calculate albedo value of reflector which is necessary for criticality safety analysis. This computer code uses albedo constant library on neutron reflection and transmission rate of each reflector material of standard thickness. The albedo constants of water, ordinary concrete and SUS-304 have been prepared. Albedo of multi-layers composed of different materials is easily calculated with short computing time. The albedo values computed with this code show good agreement with those with one dimensional transport code ANISN-JR. This report is a user's manual for this code.

1239 **(JAERI-M—88-108) Development of design system for in-vessel manipulator of fusion reactor.** Adachi, Junichi; Kobayashi, Takeshi; Iida, Hiromasa. (Kawasaki Heavy Industries Ltd., Kobe (Japan)). (Japan Atomic Energy Research Inst., Tokyo). Jun 1988. 23p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755216/JAW.

Parameters such as the scope of movement and the maximum outreach have been used as the performance index for the design of manipulators so far. Recently many computer aided design systems have been developed to carry out studies of movements, postures and interference problems and analyses of dynamic

loads and so on. But most of the above mentioned design approaches are based on experiences and know-hows of designers and do not use the quantitative indexes. On the other hand, some quantitative measures of manipulating ability of manipulators have been proposed recently. In this paper, we have developed a design system for arm mechanisms adopting the measure of manipulatability as the quantitative measures of manipulating ability of robot arms, which is useful to evaluate the manipulation performance of in-vessel manipulators for fusion reactors. The present design system has been applied to design the in-vessel manipulator for the Fusion Experimental Reactor (FER) to confirm the effectivity, and is useful to design arm mechanisms for realization of optimum manipulation performance in other fields.

1240 **(JAERI-M—88-118) Performance test report of improved 'HEPA filter unit'. Compared with 'JAERI-ISE type unit and common type unit'.** Matsumoto, Hatsuo; Ise, Yukimasa. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 26p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755219/JAW.

The performance of JAERI-Type Filter Housing Model-ISE was tested for the purpose of finding out posibility to reduce the construction cost and to minimize the installation space of filter housings in exhaust machinary room which occupy the large amount of space in the nuclear power facilities, etc. And also, Model-ISE filter housing, featured different internal construction from that of conventional type, was expected to be proved by the test to have improved performance compared to the conventional type filter housings. The performance test was executed to compare performance of prototype of Model-ISE filter to that of the conventional one on the following items, resulting that Model-ISE filter was proved to have no inferior performance to the performance of conventional type filter. 1) Resistance to Air Flow. 2) Air Velocity Test. 3) Air Flow Distribution Test. 4) Efficiency for Submicron Particles. 5) Synthetic Dust Clogging. By the above test, Model-ISE filter was proved to have many advantage c.f. less installation space (approx. 10 {similar←to} 30 % less), and lower filter height (approx. 10 {similar←to} 15 % lower) than those of conventional type without performance reduction.

1241 **(LA—11381-MS) Ventilation system history of a plutonium analytical chemistry laboratory.** Dahlby, J.W.; George, W.E.; Gonzales, M.; Stafford, R.G. (Los Alamos National Lab., NM (USA)). Sep 1988. Contract W-7405-ENG-36. 20p. NTIS, PC A03/MF A01. Order Number DE89002097/JAW.

The Chemistry and Metallurgy Research Building at Los Alamos has been used for nuclear materials research and development for the past 35 years. In this report, we describe the operation of the building with emphasis on its unique air ventilation system and on the experience gained by the Analytical Chemistry Group, one of the building occupants, over this period. 24 figs.

1242 **(LA-UR—88-3062) A real-time radiation mapping system.** Scoggins, W.A.; VanEtten, D.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-881232—6). NTIS, PC A02. Order Number DE89000353/JAW.

From 22. health physics midyear topical meeting on instrumentation; San Antonio, TX, USA (4 Dec 1988).

A prototype of a real-time radiation mapping system, Ranger, was developed to respond to an accident involving the release of plutonium for the Department of Energy's Accident Response Group. In 1987 Ranger demonstrated that it can provide an efficient method of monitoring large areas of land for radioactive contamination. With the experience gained from the operation of the prototype, the external computer and software are being upgraded in order to obtain a fully operational system. The new system uses the prototype's commercially available line-of-sight microwave system for determining position and the same radiation detection instruments. The data obtained from the radiation detection instrument(s) are linked back to the external computer along with the relative position of the measurement through the ranging system. The data are displayed on a gridded map as colored circles and permanently stored in real-time. The different colors represent different contamination levels. Contours can be drawn using the permanently stored data. 4 figs.

1243 **(MLM—3547(OP)) Recommended practice-006 "testing cleanrooms": Revision status report.** Mielke, R.L.; Swinehart, D.C. (EG and G Mound Applied Technologies, Miamisburg, OH (USA)). 1988. Contract AC04-76DP00053. 2p. (CONF-880933—4). NTIS, PC A02/MF A01. Order Number DE89001483/JAW.

From 9. annual international symposium on contamination control; Los Angeles, CA, USA (26 Sep 1988).

As it prepares for re-release and removal of the document's tentative status, the RP-6 Working Group is addressing a number of areas in the document that need clarification or updating. Proposed clarifications will attempt to avoid misinterpretations regarding suitability of certain test methods and misconceptions about choices between methods that are presented as alternatives but are not, in fact, equivalent. Updating actions under consideration will incorporate technological advances in testing methods and instrumentation. Deletion has been proposed for test methods no longer considered appropriate to the context of this document. In some cases, descriptions of methods may be removed and replaced with references to other documents which have covered them adequately and authoritatively.

1244 **(N—88-23999) Comparison of experimental and calculated thin-shell leading-edge buckling due to thermal stresses.** Jenkins, J. M. (National Aeronautics and Space Administration, Edwards AFB, CA (USA). Dryden Flight Research Center). Jul 1988. 17p. (NASA-TM—100416; H—1440; NAS—1.15:100416). NTIS, PC A03/MF A01.

High-temperature thin-shell leading-edge buckling test data are analyzed using NASA structural analysis (NASTRAN) as a finite element tool for predicting thermal buckling characteristics. Buckling points are predicted for several combinations of edge boundary conditions. The problem of relating the appropriate plate area to the edge stress distribution and the stress gradient is addressed in terms of analysis assumptions. Local plasticity was found to occur on the specimen analyzed, and this tended to simplify the basic problem since it effectively equalized the stress gradient from loaded edge to loaded edge. The initial loading was found to be difficult to select for the buckling analysis because of the transient nature of thermal stress. Multiple initial model loadings are likely required for complicated thermal stress time histories before a pertinent finite element buckling analysis can be achieved. The basic mode shapes determined from experimentation were correctly identified from computation.

1245 **(PB—88-236609/XAB) NIOSH (National Institute for Occupational Safety and Health) certified equipment list as of October 1, 1987.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1987. 412p. (DHHS/PUB/NIOSH—88-107). NTIS, PC A18/MF A01.

Also available from Supt. of Docs. See also PB—84-182211.

Commercial personal protective devices and industrial-hazard measuring instruments certified by NIOSH as of October 1, 1986, were listed. The publication also contained information about the certified coal-mine-dust personal sampler units and respirators, updated the list of approval applications, and listed some of the more common cautions and limitations for specific respirator classes. Certification information was provided for self-contained breathing apparatus for entry into and escape and for escape only situations; for gas masks useful against ammonia, chlorine, sulfur dioxide, acid gases, organic vapors, carbon monoxide, pesticides and other gases and vapors; for various types of supplied air respirators; for particulate respirators involved in single use situations, dusts and mists, fumes, and high efficiency types; for chemical cartridges effective against ammonia, methylamines, chlorine, hydrogen chloride, sulfur dioxide, organic vapor, paints, lacquers, enamels, pesticides, vinyl chloride, and other gases and vapors; and powered air purifiers. The names and addresses of manufacturers and distributors were provided.

1246 **(SAND—88-1818C) Robotic mechanical assembly in manufacturing: Force directed insertions.** Strip, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-881140—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012330/JAW.

From 2. international symposium on robotics and manufacturing research, education and applications; Albuquerque, NM, USA (16 Nov 1988).

Definition of robotic primitives for insertions is an essential step in achieving a truly flexible manufacturing environment. We present techniques based on active compliance implemented with hybrid force-position control capable of inserting a wide variety of shaped pegs. Analysis of this method indicates that it will work on arbitrarily shaped convex pegs, and may frequently work on non-convex pegs as well. The technique presented here provides a significant step toward simplifying the programming of a flexible manufacturing environment. 11 refs., 1 fig.

1247 **(SAND—88-1878C) The role of model based control in robotics.** Harrigan, R.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-881140—1). NTIS, PC A03. Order Number DE88012857/JAW.

From 2. international symposium on robotics and manufacturing research, education and applications; Albuquerque, NM, USA (16 Nov 1988).

This paper discusses the use of model based control of industrial robots to achieve automatic programming of robot trajectories, hybrid force/position control and computer assisted manual operation. Experiments at Sandia National Laboratories are reviewed to illustrate the impact of model based control on the operation of robotic systems. Computer models of the robots and their operating environments are complemented with environmental sensing. Sensing allows, for example, correlation of modeled geometries with the location of objects in the actual environment. In addition, sensors detect error situations which may require operator attention prior to continued system operation. Computer models are used to verify the validity of sensor data before the robotic system executes operations based upon those data. 11 refs., 5 figs.

1248 **(SAND—88-2202) Primary standards laboratory report, 1st half 1988.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01. Order Number DE89001660/JAW.

Sandia National Laboratories operates the Primary Standards Laboratory (PSL) for the Department of Energy, Albuquerque Operations Office (DOE/AL). This report summarizes metrology activities that received emphasis in the first half of 1988 and provides information pertinent to the operation of the DOE/AL system-wide Standards and Calibration Program.

1249 **(SAND—88-2543) ASP [AntiSubmarine Penetrator] base plate redesign and explosive bolt test.** Cole, J.K.; Wolfe, W.P. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1988. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01. Order Number DE89001659/JAW.

This report presents the results of a post-flight investigation of the Rocket Antisubmarine Penetrator (RAP) tests of the Anti-Submarine Penetrator (ASP). It focuses on the cause for the premature deployment of the on-board recovery system and the failure of the base pressure transducers. As a result of the investigation, the base plate of the ASP vehicle was modified to increase its structural stiffness. Also, an instrumented test was conducted to assess the environment that is created when the three explosive bolts are activated to separate the vehicle from the interstage adapter and the rocket booster. The results of this test are presented and discussed. 5 refs., 15 figs.

1250 **(UCRL—21126) Real-time digital signal processing hardware designs, Phase 3: Final report, October 1, 1986--September 30, 1987.** Current, K.W.; Jain, A.K.; Wagner, M.; Parkhurst, J.; Sturm, S. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA)). 1 Oct 1987. Contract W-7405-ENG-48. 86p. NTIS, PC A07/MF A01. Order Number DE89002167/JAW.

Completed and submitted to the IEEE Transactions on Acoustics, Speech, and Signal Processing is the research undertaken by Matt Wagner on "An Evaluation of Real-Time Adaptive Noise Cancelling Algorithms Using the TMS 32020 Digital Signal Processor" in which sophisticated lattice algorithms are evaluated. The results are briefly summarized here. It is also attached as the Appendix to this report. In preparation for continued work using DSP chips, we have requested a copy of the simulator for the floating-point arithmetic version of the TMS 320. Literature searches for newly available and announced DSP chips, and additional presentations of applications of lattice algorithms are continuing. The IC layout design stations in the Electronics Research Lab at UCD have been used to design one CMOS test chip and two NMOS integrated circuits that have been and are being submitted to MOSIS for fabrication (at no expense to LLNL). Nearly completed is the design of a single-chip Discrete Cosine Transform/Inverse Discrete Cosine Transform (DCT/IDCT) integrated circuit that can be useful in video data compression. A CMOS test chip design was undertaken to demonstrate to ourselves and LLNL the relatively easy, inexpensive, and quick fabrication turn-around possible using inexpensive workstation hardware, public domain layout software, and the MOSIS service for fabrication. These projects are also discussed in this paper.

1251 **(UCRL—98437) X-ray microtomography on beamline X at SSRL.** Kinney, J.H.; Johnson, Q.C.; Nichols, M.C.; Bonse, U.; Saroyan, R.A.; Nusshardt, R.; Pahl, R. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48;AC04-76DR00789. 14p. (CONF-8808141—1). NTIS, PC A03. Order Number DE89000497/JAW.

From 3. international conference on synchrotron radiation instruments; Tokyo, Japan (29 Aug 1988).

The development of high-intensity synchrotron beamlines as well as advances in solid state imaging detectors has lead to efforts to develop high-resolution computed tomography (CT) capabilities for studies in materials and biological science. Conventional CT instrumentation used for diagnostic radiology or non-destructive evaluation does not have the spatial resolution required to perform many of the micro characterization studies of interest to the scientific community. Furthermore, dual-energy CT for elemental and chemical mapping requires high x-ray intensity and spectral density, and these are impractical to achieve using non-synchrotron sources. This paper describes a high-resolution three-dimensional CT system using SR which we have developed to perform studies of supported catalysts, composite materials and crack growth. The present spatial resolution (on beamline X-2) is better than 10-μm in each of three-dimensions and shows promise for improvement to 1-μm. The ability to detect high contrast flaws, for example cracks, is presently 1-μm or better based on our studies of thin films. 16 refs., 3 figs.

1252 **(UCRL—98631) Device-oriented qualitative reasoning for dynamic physical systems.** Macfarlane, J.F.; Donath, M. (Lawrence Livermore National Lab., CA (USA)). 27 Jul 1988. Contract W-7405-ENG-48. 6p. (CONF-881120—14). NTIS, PC A02/MF A01. Order Number DE89001123/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

There are few tools to assist the engineer in the initial phase of a design and analysis of a dynamic system. This paper illustrates the utility of a device-oriented qualitative reasoning system as a tool for generating generalized system behavior information which is invaluable information to the designer. For the first time, a qualitative model is presented in terms of its underlying continuous representation. A phase plane analysis, an analysis tool which can only be automated if specific parameter information is defined, is presented for the continuous representation and a qualitative analysis is presented for the qualitative model. The phase plane and state transition diagram, the result of the qualitative analysis, are shown to capture equivalent information. This comparison highlights the ability of qualitative reasoning techniques to provide an automated approach to deriving general system behavior in the absence of specific parameter information. 9 refs., 5 figs., 5 tabs.

1253 **(UCRL—99473) The effect of transverse stress on the critical current of Nb_3Sn cable-in-conduit superconductors.** Summers, L.T.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 19 Aug 1988. Contract W-7405-ENG-48. 6p. (CONF-880812—16). NTIS, PC A02. Order Number DE89001497/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

We have investigated the effects of transverse stress on the critical current of Nb_3Sn Cable-In-Conduit Conductors (CICC). The sensitivity of the critical current (I/sub c/) to applied stress at 12 T has been determined for CICC's with helium void fractions (f/sub He/) in the range of 0.25--0.4. I/sub c/ has been found to be a function transverse stress with good correlation to single wire data up to stress levels of 50 MPa. At higher stress levels the CICC's show significantly higher degradation with transverse stress. No clear correlation has been found between the stress sensitivity of I/sub c/ and f/sub He/. The results fall into a broad band suggesting that geometric factors, such as wire position within the cable bundle, exert a strong influence on the I/sub c/ vs. stress dependence. 16 refs., 4 figs., 1 tab.

1254 **(WHC-SA—0418) Transportable criticality alarm system.** Clem, W.E. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1988. Contract AC06-87RL10930. 9p. (CONF-8809144—5). NTIS, PC A02/MF A01. Order Number DE89001917/JAW.

From DOE criticality alarm system workshop; Richland, WA, USA (20 Sep 1988).

The Transportable Criticality Alarm System was developed at the Hanford Site in 1982 to comply with the requirements of US Department of Energy Order DOE 5480.1, 12/18/80, and ANSI/ANS-8.3- 1979. The portable unit that it replaced failed to comply with the new requirements in that it did not provide the necessary warning of malfunctions, nor did it provide the Hanford Site standard criticality alarm signal. Modern technology allowed the Transportable Criticality Alarm System to comply with the criticality requirements cited and to incorporate other features that make it more usable, maintainable, and reliable. The Transportable Criticality Alarm System (TCAS) provides temporary criticality coverage in manned areas where the facility criticality alarm system is not operable. This gamma radiation-sensitive system has been in use for the past 6 yr at the Hanford Site. 2 refs., 4 figs., 1 tab.

1255 **Rf-driven Josephson junctions: Tails on the Shapiro steps of the I-V curves.** Chi, C.C.; Vanneste, C.; Gallagher, W.J.; Kleinsasser, A.W.; Raider, S.I.; Sandstrom, R.L. (I.B.M. Thomas J. Watson Research Center, Yorktown Heights, New York 10598). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 9227-9230(1 Nov 1988).

rf-driven Josephson junctions have been experimentally studied in a wide parameter range corresponding to the low-frequency boundary of the chaotic regime, where the I-V curves display characteristic large negative-going tails on top of the Shapiro steps. The tail, in units of the Shapiro step spacing, has been found to increase with decreasing damping of the junction, in agreement with theoretical predictions using the resistively-shunted-junction model.

1256 **(N—88-25668) Study of a magnetic refrigerator for space applications for temperatures under 20 K.** Seyfert, P. (National Aeronautics and Space Administration, Washington, DC (USA)). Jun 1988. Translation of Etude d'un Refrigerateur Magnetique a Vocation Spatiale pour des Temperatures Inferieures a 20 Kelvins, Commissariat a l'Energie Atomique Grenoble (France), 1-48(26 May 1986). (NASA-TT—20283; NAS—1.77:20283; ESA-CR(P)—2311; ETN—87-99866). 35p. NTIS, PC A03/MF A01.

A thermodynamical analysis of the integration of a magnetic cycle in a refrigeration cycle; the process configuration choices; and the implementation of the first design of a last stage refrigeration step within a minimal overall weight design concept are summarized. The feasibility of magnetic cooling to 4 K design temperature is demonstrated. Compared to Joule-Thompson systems, the overall weight is of the same order.

1257 **A device for microwave sintering large ceramic articles.** Kimrey, H.D. Jr. US Patent Application 6-077,580. 24 Jul 1987. 14p. Contract AC05-84OR21400. NTIS, PC A03/MF A01.

A microwave sintering system is provided for uniform sintering of large and/or irregular shapes ceramic articles at microwave frequencies of at least 28 GHz in the hundreds of kilowatts power range in an untuned cavity. A 28 GHz, 200 kw gyrotron with variable power output is used as the microwave source connected to an untuned microwave cavity formed of an electrically conductive housing. The part to be sintered is placed in the cavity and supported on a removable high temperature table in a central location within the cavity. The part is surrounded by a microwave transparent bulk insulating material to reduce thermal heat loss at the part surfaces and maintain more uniform temperature. The cavity may be operated at a high vacuum to aid in preventing arcing. The system allows controlled increased heating rates of greater than 200{degree}C/min to provide rapid heating of a ceramic part to a selected sintering temperature where it is maintained by regulating the microwave power applied to the part. As a result of rapid heating, the extent on non-isothermal processes such as segregation of impurities to the grain boundaries are minimized and exaggerated grain growth is reduced, thereby strengthening the mechanical properties of the ceramic part being sintered. 1 fig.

1258 **Closure system.** Hertelendy, N.A. US Patent Application 6-041,267. 22 Apr 1987. 14p. Contract AC06-77RL01030. NTIS, PC A03/MF A01.

A pressure resistant seal for a metallic container is formed between a cylindrical portion having one end open and a cap which seals the open end of the shell. The cap is in the form of a frusto-conical flange which is inserted narrow end first into the open end of the shell and the container is sealed by means of a capping tool which pulls the flange against a die, deforming the flange and forcing the edge of the flange into the wall of the shell. 6 figs.

4203 Lasers

REFER ALSO TO CITATION(S) 1502, 1580, 2571

1259 **(AD-A—195845/3/XAB) Autoionization for lower-level detrapping in x-ray lasers. Interim report.** Elton, R.C. (Naval Research Lab., Washington, DC (USA)). 9 May 1988. 23p. (NRL—9103). NTIS, PC A03/MF A01.

A novel type of x-ray laser is analyzed in which the population of the lower level is depleted by autoionization instead of by spontaneous decay. The intention is to decrease radiative trapping effects that quench the gain and require microscopic plasmas. Proof-of-principle atomic-physics experiments and numerical modeling are needed to verify predicted feasibility, fluorescence, and lasing.

1260 **(AD-A—195961/8/XAB) Vanderbilt free-electron-laser project in biomedical and materials research. Annual report, 1 February 1987-31 January 1988.** Haglund, R.F.; Tolk, N.H. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). Jun 1988. 17p. NTIS, PC A03/MF A01.

The Medical Free Electron Laser Program was awarded to develop, construct and operate a free-electron laser facility dedicated to biomedical and materials studies, with particular emphases on: fundamental studies of absorption and localization of electromagnetic energy on and near material surfaces, especially through electronic and other selective, non-statistical processes; non-thermal photon-materials interactions (e.g., electronic bond-breaking or vibrational energy transfer) in physical and biological materials as well as in long-wavelength biopolymer dynamics; development of FEL-based methods to study drug action and to characterize biomolecular properties and metabolic processes in biomembranes; clinical applications in otolaryngology, neurosurgery, ophthalmology and radiology stressing the use of the laser for selective laser-tissue, laser-cellular and laser-molecule interactions in both therapeutic and diagnostic modalities.

1261 **(AD-A—195974/1/XAB) Tolerances for phase locking of semiconductor-laser arrays. Technical report.** Garmire, E.M. (Aerospace Corp., El Segundo, CA (USA). Electronics Research Lab.). 18 Apr 1988. 25p. (TR—0086(6925-04)-1). NTIS, PC A03/MF A01.

Fabrication and operating conditions for semiconductor-laser arrays to be phase locked are described. The analysis is based on a linear theory of the locking of coupled oscillators. Results show that the refractive index of adjacent lasers must be the same to approx. 0.0001. This puts close tolerances on fabrication if phase locking is to be maintained. The average aluminum concentration in adjacent stripes must be the same to within approx. 0.0001, while the average epilayer thickness must be the same to within 0.2%, or a tolerance of 3 a on the active layer. Changes in refractive index due to free-carrier injection provide an additional tolerance condition, which translates to a requirement that the stripe width and contact resistance be uniform to within a few percent. In addition, because thermal profiles may be detrimental, careful heat-sinking is required. These fabricational tolerances support the fact that high-quality epilayers such as grown by molecular-beam epitaxy (MBE) and metal-organic chemical vapor deposition (MOCVD) are usually required for phase-locked laser arrays, and that photoresist processing and bonding must be done carefully.

1262 **(AD-A—195978/2/XAB) Bibliography of Soviet laser developments, Number 88, March-April 1987.** (Defense Intelligence Agency, Washington, DC (USA). Directorate for Scientific and Technical Intelligence). 3 Mar 1988. 172p. (DIA-DST—2700Z-002-88). NTIS, PC A08/MF A01.

This is the Soviet Laser Bibliography for March-April 1987, and is No. 88 in a continuing series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications systems; beam propagation; adaptive optics; computer technology; holography; laser-induced chemical reactions; measurement of laser parameters; laser measurement applications laser-excited optical effects; laser spectroscopy; beam-target interaction; and plasma generation and diagnostics.

1263 **(AD-A—195991/5/XAB) Research on a two-stage free-electron-laser oscillator. Final report.** (Berkeley Research Associates, Inc., CA (USA)). Mar 1988. 98p. (BRA—88-W032R). NTIS, PC A05/MF A01.

The research involved the theoretical and numerical analysis of the physics of free-electron lasers using relativistic particle beams. The major emphasis of the research was to obtain design criteria for the development of a two-stage FEL oscillator operating in the trapped-particle mode. The present work was centered on the development of a fully relativistic, nonlinear analysis of the spatial and temporal evolution of multiple modes within a free electron laser oscillator and of a large-amplitude, nonlinearly saturated state characteristic of trapped-particle mode operation. The equations solved are the Maxwell equations of electrodynamics coupled with the collisionless Boltzmann equation that describes collisionless particles under influence of the electromagnetic fields. The electromagnetic fields include the radiation fields from the FEL and the self-electric fields from the longitudinal potential due to the space charge, i.e., the dominant component of the interparticle Coulomb forces. The particle dynamics transverse to the magnetic axis are included, but gradients in the radiation fields are ignored. The electron-beam equilibrium is assumed to be spatially uniform and temporally stationary. Justification and probable impact of further approximations are discussed in the technical section of this report. The approximations employed are consistent with the purpose of obtaining experimentally implementable design criteria for the FEL oscillator.

1264 **(AD-A—196170/5/XAB) Nonlinear optical phase-conjugation techniques to reduce the physical size of lasers. Final technical report, May-July 1987.** Pratt, H.L. (Army Missile Command, Redstone Arsenal, AL (USA). Advanced Sensors Directorate). Sep 1987. 22p. (AMSMI/TR-RD-AS—87-19). NTIS, PC A03/MF A01.

Optical phase conjugation involves the use of various techniques to reverse the wavefront of an optical beam. Nonlinear optical interactions within various media may be used to generate phase conjugation. This report reviews the most-promising techniques for nonlinear optical phase conjugation and postulates how phase conjugation might be used to reduce the physical size of laser systems. A number of examples from literature are cited.

1265 **(INIS-mf—11813) Development of electrical excited CO/sub 2/-laser with transversal gas flow as well an axial flowed CO/sub 2/-laser for material treatment, in particular for cutting.** Wollermann-Windgasse, R.; Ackermann, F. (Trumpf G.m.b.H. und Co., Ditzingen (Germany, F.R.). Maschinenfabrik Stuttgart; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Apr 1987. 155p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755169/JAW.

The project describes the development of a new generation of CO/sub 2/-lasers using high frequency discharge (13.56 MHz) for laser excitation by capacitive dielectrical input. HF-excitation has a lot of advantages compared with direct current technology, these are higher electrical input power into the plasma, better homogeneity and stability of discharges. In addition to this, HF-excitation shows excellent possibilities for pulsing and modulation. As a result of this, there are compact powerful laser systems with the possibility of scaling up to the multi-kW-range. The examination included fast transversal flowed as well as fast axial flowed systems. In the end of this project development prototypes with laser output power of 1000 W, 1500 W and 3000 W were available. Detailed attempts of application show that these lasers on grounds of excellent laser output quality and controlability of laser power specifically to each process make possible new ways for material treatment by laser.

1266 **(LA-UR—88-3613) One-dimensional simulation of a free-electron laser oscillator using a diffraction grating as a cavity mirror.** Takeda, H.; Sollid, J.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 22p. (CONF-8808146—4). NTIS, PC A03/MF A01. Order Number DE89002292/JAW.

From 10. international free-electron laser conference; Jerusalem, Israel (29 Aug 1988).

The free-electron laser (FEL) oscillator is known to excite parasitic sideband wavelengths in addition to the fundamental wavelengths at high intracavity power. When a tapered wiggler is used, the sidebands reduce the extraction efficiency. To eliminate the sidebands and to increase the extraction efficiency, we studied an FEL cavity with one of the mirrors ruled as a diffraction grating. The diffraction grating deflects the light in the cavity selectively according to the wavelength: the sidebands can be eliminated by deflection to off-axis of the cavity. Because the grating mirror must be mounted with an angle, laser pulse is stretched after diffraction. The pulse stretching reduces optical intensity. We studied the effect of pulse stretching numerically using a one-dimensional FEL code FELP. Using this code, the free-electron laser performance is calculated and compared with different line densities of grating for the following three wigglers: an untapered wiggler, a 12% wavelength tapered wiggler, and a wiggler tapered in wave number by 30%. The wavelength aperture caused by the grating also is studied as a function of line density. 2 refs., 11 figs.

1267 **(N—88-23841) Theoretical studies of resonance enhanced stimulated raman scattering (RESRS) of frequency doubled Alexandrite laser wavelength in cesium vapor. Progress report, July-December 1987.** Lawandy, N.M. (Brown Univ., Providence, RI (USA)). 1987. 10p. (NASA-CR—182871; NAS—1.26:182871). NTIS, PC A02/MF A01.

The third phase of research will focus on the propagation and energy extraction of the pump and SERS beams in a variety of configurations including oscillator structures. In order to address these questions a numerical code capable of allowing for saturation and full transverse beam evolution is required. The method proposed is based on a discretized propagation energy extraction model which uses a Kirchoff integral propagator coupled to the three level Raman model already developed. The model will have the resolution required by diffraction limits and will use the previ-

ous density matrix results in the adiabatic following limit. Owing to its large computational requirements, such a code must be implemented on a vector array processor. One code on the Cyber is being tested by using previously understood two-level laser models as guidelines for interpreting the results. Two tests were implemented: the evolution of modes in a passive resonator and the evolution of a stable state of the adiabatically eliminated laser equations. These results show mode shapes and diffraction losses for the first case and relaxation oscillations for the second one. Finally, in order to clarify the computing methodology used to exploit the speed of the Cyber's computational speed, the time it takes to perform both of the computations previously mentioned to run on the Cyber and VAX 730 must be measured. Also included is a short description of the current laser model (CAVITY.FOR) and a flow chart of the test computations.

1268 **(N—88-23971) Theoretical studies of solar-pumped lasers. Progress report, 16 January- 5 June 1988.** Harries, W. L. (Old Dominion Univ., Norfolk, VA (USA)). Jun 1988. 18p. (NASA-CR—182929; NAS—1.26:182929; PTR—88-5). NTIS, PC A03/MF A01.

The investigation of stimulated emission causing transitions from the B(1) pi sub u state of sodium to the overlapping 2(1) sigma(+) sub g electronic state has been continued. A new method of estimating the Franck-Condon factors has been developed which instead of fitting the molecular potential curves with Morse functions, estimates the V(r) dependence by interpolation from given potential curves. The results for the sum of the rates from one vibrational level in the upper state to all the levels in the lower state show good agreement with the previous method, implying that curve crossing by stimulated emission due to photons from the oven is an important mechanism in sodium.

1269 **(N—88-23972) Theoretical studies of solar lasers and converters. Progress report, January-July 1988.** Heinbockel, J. H. (Old Dominion Univ., Norfolk, VA (USA)). Jun 1988. 22p. (NASA-CR—182927; NAS—1.26:182927). NTIS, PC A03/MF A01.

The previously constructed one dimensional model for the simulated operation of an iodine laser assumed that the perfluoroalkyl iodide gas n-C3F7I was incompressible. The present study removes this simplifying assumption and considers n-C3F7I as a compressible fluid.

1270 **(N—88-24948) Distributed feedback lasers. Final report, 19 June 1984-19 June 1986.** Ladany, I.; Andrews, J.T.; Evans, G.A. (David Sarnoff Research Center, Princeton, NJ (USA)). Jun 1988. 86p. (NASA-CR—4154; NAS—1.26:4154; RCA-PRRL—87-CR-3B). NTIS, PC A05/MF A01.

A ridge waveguide distributed feedback laser was developed in InGaAsP. These devices have demonstrated CW output powers over 7 mW with threshold currents as low as 60 mA at 25 C. Measurements of the frequency response of these devices show a 3 dB bandwidth of about 2 GHz, which may be limited by the mount. The best devices have a single mode spectra over the entire temperature range tested with a side mode suppression of about 20 dB in both CW and pulsed modes. The design of this device, including detailed modeling of the ridge guide structure, effective index calculations, and a discussion of the grating configuration are presented. Also, the fabrication of the devices is presented in some detail, especially the fabrication of and subsequent growth over the grating. In addition, a high frequency fiber pigtailed package was designed and tested, which is a suitable prototype for a commercial package.

1271 **(N—88-25185) Design of catalytic monoliths for closed-cycle carbon dioxide lasers. Progress report.** Herz, R.K. (California Univ., San Diego (USA)). Jun 1988. 30p. (NASA-CR—182983; NAS—1.26:182983; UCSD—88-5205). NTIS, PC A03/MF A01.

A computer program was written that allows the design of catalytic monoliths for closed-cycle carbon dioxide lasers. Using design parameters obtained from workers at NASA Langley Research Center and from the literature, several specific monoliths were designed and the results were communicated to the research group working on this project at Langley. Two oral presentations were made at NASA-sponsored workshops - at Langley in January 1988 and in Gainesville, Florida in May 1988.

1272 **(UCRL—99391) Free-electron laser results from the Advanced Test Accelerator.** Orzechowski, T.J.; Miller, J.L.; Weir, J.T.; Chong, Y.P.; Chambers, F.; Deis, G.A.; Paul, A.C.; Prosnitz, D.; Scharlemann, E.T.; Hallbach, K. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48;AC03-76SF00098. 6p. (CONF-881049—27). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE89001925/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

PALADIN is a 10.6-μm FEL amplifier experiment operating at the Lawrence Livermore National Laboratory's Advanced Test Accelerator, an induction linear accelerator designed to produce a 45-MeV, 10-kA electron beam. With a 15-m long wiggler, PALADIN demonstrated 27 dB of exponential gain from a 14-kW input signal. With a 5-MW input signal, the amplifier saturated after 10 dB of gain. The exponentially growing signal in the unsaturated amplifier was clearly seen to be gain guided by the electron beam. 7 refs., 8 figs.

1273 **Threshold characteristics of epitaxial Al(Ga,As) surface-emitting lasers with integrated quarter-wave high reflectors.** Gourley, P.L.; Drummond, T.J.; Zipperian, T.E.; Reno, J.L.; Plut, T.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **64**: No. 11, 6578-6580(1 Dec 1988).

We report a study of threshold characteristics of as-grown surface-emitting lasers fabricated with molecular-beam epitaxy by the monolithic integration of two quarter-wave high reflectors (mirrors) of AlAs/Al/sub 0.4/Ga/sub 0.6/As surrounding an active spacer layer. The spacer was either a multiple quantum well of GaAs/Al/sub 0.4/Ga/sub 0.6/As (100 A/200 A) or GaAs. Several structures were grown corresponding to different mirror reflectance and different spacer thicknesses from ultrashort 0.9 to 10 μm. One of the structures was chemically etched to form a two-dimensional array of microlasers. All of the structures were photopumped at room temperature, and the lasing threshold was determined. Without any lateral confinement, the threshold irradiance was as low as 2 x 10^5 W/cm^2. Near-field images of the light emitted slightly above threshold reveal several competing filaments. This competition broadens the lasing linewidth, but can be controlled by lateral confinement schemes.

1274 **Multiple pulse laser excitation of capillary discharge.** Lee, R.W.; Zigler, A. (Lawrence Livermore National Laboratory, L-23, Livermore, California 94550). *Applied Physics Letters;* **53**: No. 21, 2028-2029(21 Nov 1988).

The results of a proof of principle experiment is presented to illustrate the utility of the capillary discharge as a medium for the efficient production of soft x-ray lasing. The duration of the capillary discharge plasma, 8 μs, is long enough to allow multiple pulses from a Q-switched mode-locked Nd glass laser to be used as a heating source to create a hot, relatively dense plasma several times per discharge.

1275 **Role of intensity fluctuations in laser-beam apodization with a graded random phase window.** Haas, R.A. (Department of Applied Science, University of California, Davis/Livermore, P. O. Box 808, L-794, Livermore, California 94550). *Optics Letters;* **13**: No. 11, 943-945(Nov 1988).

Analysis indicates that a transparent window with graded random surface modulation will apodize a laser beam. Following the apodizer the laser beam consists of a scattered component of mean intensity I-bar/sub s/ and an apodized component of mean intensity I-bar/sub a/. The apodizer intensity transmission is exp[-$k^2(n-1)^2 \sim (t^2)(r)$], , where $\sim(t^2)(r)$ is the window surface modulation mean-squared amplitude, k is the radiation wave number, and n is the window refractive index. Interference between the scattered and unscattered radiation produces intensity fluctuations similar to laser speckle. For high-power applications, minimization of the

probability of optical damage due to intensity fluctuations requires that I-bar/sub a//I-bar/sub s/approx. $>10^3$.

1276 **Laser-linewidth measurement with a Fizeau wavemeter.** Reiser, C.; Esherick, P.; Lopert, R.B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Optics Letters;* **13**: No. 11, 981-983(Nov 1988).

It is shown theoretically and experimentally that a Fizeau wedge wavemeter typically used to measure laser wavelength can also be used to measure the linewidth of a pulsed or cw laser. Linewidths as small as a few hundred megahertz can be measured by choosing the thickness of the wedge properly.

1277 **(AD-A—196211/7/XAB) Vibrational relaxation processes in CO_2-N_2-H_2O laser systems.** Haixing, Y. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 9 Jun 1988. Trans. of Jiguang (China), Vol. 8, No. 11, 11-17(1981). (FTD-ID(RS)T—0258-88). 20p. NTIS, PC A03/MF A01.

This article discusses a number of important questions concerning relaxation processes: the V-V energy-transfer mechanism inside CO_2(v3) molecules; the mechanisms involved in the main reactions of water on relaxation processes; resonant energy transfer between nu1 and nu2 in CO_2; similarities and differences in the relaxation rates for expansion and compression flows; and, possibilities of non-equilibrium existing between different levels of rotational energy and between different levels of vibrational energy within the same vibrational mode. The article points out that it is necessary to do more-detailed research on these questions. The content of these discussions is also appropriate for use with other gas-laser systems.

1278 **Frequency stabilization of a diode laser to a Fabry-Perot interferometer.** Chung, Y.C.; Shay, T.M. (Utah State Univ., Dept. of Electrical Engineering, Logan, UT (US)). *Optical Engineering;* **27**: No. 5, 424(May 1988).

A commercial GaAlAs diode laser is frequency locked to a Fabry-Perot interferometer. The temperature stabilization loop of this diode laser system maintains the relative frequency stability within 11 kHz. When the frequency control loop is closed, the relative frequency stability is improved to 450 Hz. A previously neglected frequency offset is also analyzed. This offset is a result of the injection current modulation technique commonly used to frequency lock diode lasers. The calculated frequency offset in the system is 150 kHz.

1279 **Synthetic laser medium.** Stokowski, S.E. US Patent Application 6-110,387. 20 Oct 1987. 18p. Contract W-7405-ENG-48. NTIS, PC A03/MF A01.

A laser medium is particularly useful in high average power solid state lasers. The laser medium includes a chromium dopant and preferably neodymium ions as codopant, and is primarily a gadolinium scandium gallium garnet, or an analog thereof. Divalent cations inhibit spiral morphology as large boules from which the laser medium is derived are grown, and a source of ions convertible between a trivalent state and a tetravalent state at a low ionization energy are in the laser medium to reduce an absorption coefficient at about one micron wavelength otherwise caused by the divalent cations. These divalent cations and convertible ions are dispersed in the laser medium. Preferred convertible ions are provided from titanium or cerium sources.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 17, 609, 634, 877, 1220, 1484, 2120, 2652, 2695

1280 **(AD-A—195546/7/XAB) Hypersonic flow over a six-finned configuration.** Agnone, A.M.; Zakkay, V.; Weinacht, P. (New York Univ., Westbury, NY (USA). Antonio Ferri Labs.). 1988. 7p. NTIS, PC A02/MF A01.

Pub. in Experiments in Fluids, Vol. 6, 237-242(1988).

Experimental data of the flow field over a six-finned configuration are compared with computations from an inviscid Euler code and a parabolized Navier-Stokes(PNS)code to assess their accuracy. Surface oil flow patterns, surface pressures, and flow field pitot surveys are presented. The PNS computations are in good agreement with the measurements in the inviscid regions. Differences are noted in the viscous regions possibly due to nose-tip bluntness effects and the associated entropy layer.

1281 **(AD-A—196111/9/XAB) Numerical solutions of unsteady inviscid transonic turbine cascade flows. Doctoral thesis.** Moore, R.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). May 1988. 281p. (AFIT/CI/NR—88-8). NTIS, PC A13/MF A01.

A numerical analysis was developed to solve two-dimensional inviscid transonic turbine-type cascade flow fields. This analysis combines accuracy comparable to that of the numerical method of characteristics with the efficiency of finite-difference methods. The MacCormack explicit finite-difference method is used to solve the unsteady Euler equations. Steady solutions are calculated as asymptotic solutions in time. A conservation variable formulation of the Kentzer method has been developed in this investigation and is used to derive appropriate equations for the flowfield boundaries. The Kentzer method is based on characteristic theory, but uses a finite difference method, consistent with the method used at interior points, to integrate the appropriate boundary equations. A grid generator was been developed to crease C-type grids around cascade blades using techniques similar to the Poisson equation grid-generation techniques developed by Steger and Sorensen. Two different planar turbine-type cascades were studied. The AACE II cascade blades are typical of the nozzle blades found in the first stator in a turbine. The GMA 400 cascade blades are typical of later turbine stator blades.

1282 **(AD-A—196153/1/XAB) Boltzmann equation approach to two-phase flow turbulence. Technical report, April 1986-May 1987.** Domokos, G.; Kovesi-Domokos, S.; Zoltani, C.K. (Johns Hopkins Univ., Baltimore, MD (USA)). Mar 1988. 24p. NTIS, PC A03/MF A01.

A description of the turbulent flow of a two-phase system is given in terms of a coupled system of Boltzmann and Navier-Stokes equations. The use of a Boltzmann equation for the particle phase makes the description valid for low concentrations. The Boltzmann equation is appropriately modified to account for a velocity-dependent interphase interaction. Within the framework of the Chapman-Enskog expansion, moment equations are derived for the particle phase. The coupled system of moment equations is cast into a form suitable for a statistical description of the turbulent flow.

1283 **(BNL-NUREG—41750) Heat transfer between stratified immiscible liquid layers driven by gas bubbling across the interface.** Greene, G.A.; Irvine, T.F. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880724—26). NTIS, PC A02/MF A01. Order Number DE89001105/JAW.

From 25. American Society of Mechanical Engineers/American Institute of Chemical Engineers/American Nuclear Society national heat transfer conference; Houston, TX, USA (24 Jul 1988).

The modeling of molten core debris in the CORCON and VANESA computer codes as overlying, immiscible liquid layers is discussed as it relates to the transfer of heat and mass between the layers. This initial structure is identified and possible configurations are discussed. The stratified, gas-sparged configuration that is presently employed in CORCON and VANESA is examined and the existing literature for interlayer heat transfer is assessed. An experiment which was designed to measure interlayer heat transfer with gas sparging is described. The results are presented and compared to previously existing models. A dimensionless correlation for stratified, interlayer heat transfer with gas sparging is developed. This relationship is recommended for inclusion in CORCON-MOD2 for heat transfer between stratified, molten liquid layers. 12 refs., 6 figs., 3 tabs.

1284 **(CONF-881119—1) Shellside waterflow-induced tube vibration in heat exchanger configurations with tube pitch-to-diameter ratio of 1.42.** Halle, H.; Chenoweth, J.M.; Wambsganss, M.W. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010076/JAW.

From Symposium on flow induced vibration and noise; Chicago, IL, USA (28 Nov 1988).

The pitch-to-diameter ration (P/D) of the tube layout in shell-and-tube heat exchangers is one of the major parameters available to the designer to control heat transfer and pressure drop as well as to facilitate mechanical cleaning. As part of a comprehensive investigation of waterflow-induced tube vibration in an industrial-size research heat exchanger, various configurations characterized by different design parameters including P/D ratio had been investigated. To provide a comparison with previous data obtained with P/D = 1.25, this paper presents the results of a study of eight different tube bundle configurations with P/D = 1.42. Four equilaterally spaced tube layout patterns and two baffle edge orientations were investigated. The results indicate that the greater flow area of the P/D = 1.42 configuration increases flow penetration into the bundle, reduces the tube-to-tube vibration coupling, and generally provides less well defined, even though sometimes improved, fluidelastic instability thresholds. 8 refs., 8 figs., 1 tab.

1285 **(DOE/ER/13764—T1) Similarity requirements for two-phase flow-pattern transitions.** Schwartzbeck, R.K.; Kocamustagaogullari, G. (Wisconsin Univ., Milwaukee (USA). Dept. of Mechanical Engineering). Oct 1988. Contract FG02-87ER13764. 47p. NTIS, PC A03/MF A01. Order Number DE89001829/JAW.

Overall scaling criteria for a natural circulation loop under single-phase and two-phase flow conditions are summarized. The phase change similarity requirement is used to establish scaled-down model operating conditions for fluid-to-fluid and reduced-pressure simulations of a high-pressure water system. Based on the overall scaling methodology, additional similarity requirements are derived from two-phase flow-pattern transition boundaries for horizontal and vertical two-phase flow configurations. It is shown that flow-pattern transition scaling requirements are all different from each other. However, it is demonstrated that a solution in the form of the axial length ratio as a function of the cross-sectional area ratio and some fluid property ratio groups is possible for each flow-pattern transition studied. Finally, it is concluded that since the constitutive relation between the two-phase flow-patterns and the void fraction depends on the actual size, a completely correct scaling may be impossible to achieve and scaling compromises must be made. 30 refs., 9 figs.

1286 **(FEI—1861) On a method of boundary-value problem solution for the diffusion-type equation in the non-ideal shaped areas.** Gulevich, A.V.; Zrodnikov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704440/JAW.

Application of coordinate transformation methods and perturbation theory for solution of nonlinear elliptic equations is considered. Developed mathematical system is used in problem on coolant hydrodynamically stabilized flow in long rectilinear channels, which cross section form is close to ring or circular form. Numerical examples are considered. 9 refs.; 2 figs.

1287 **(FEI—1870) Molecular and turbulent interchannel exchange in two-phase flows.** Sorokin, A.P.; Zhukov, A.V.; Kornienko, Yu.N.; Kriventsev, V.I.; Titov, P.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704441/JAW.

Experimental investigation results of interchannel exchange in reactor fuel element assemblies are analysed for case of coolant single-phase and two-phase flows. On the base of interchannel exchange, correlation for intensity calculation of inerchannel molecular and turbulent exchage of mass, momentum and energy in coolant single-phase and two-phase flows are obtained. For two-phase flows interchannel exchange is considered within models of homogeneous flow and phases devided flow. 31 refs.; 4 figs.

1288 **(FEI—1872) Studying the liquid droplet deposition during interaction of a jet with a near-wall turbulizator in an air flow.** Perepelitsa, N.I.; Pomet'ko, R.S.; Muranov, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704443/JAW.

Problem of heat removal intensification in steam-generating pipes by means of flow turbulizator is discussed. Experimental investigation results of deposition of liquid droplets injected in form of jet into air flow behind near-wall turbulizator in form of rectangular 5 mm height protrusion placed in the channel with square cross section (20x20 mm) and 0.6 m length are given. Experiments are conducted under 0.196 - 0.294 MPa pressure, 58.9 - 92 kg/h air flowrate and 15-45 kg/h water flowrate. Calculation results of air flow mass exchange parameters by two-dimensional mathematical model in case of smooth channel are presented. It is established, that liquid flowrate in film at small distances behind near-wall turbulizator (2-3 channel calibers) is formed, mainly, due to droplets flow moving within spacing from wall which is no more, than turbulizator height. Droplet bulk from flow centre which does not collide with turbulizator deposits within more removed distances (5 and more channel calibers). At droplet collision with near-wall turbulizator about a half of liquid deposits on channel wall. At such amounts of liquid the film under the conditions of disturbed gas flow centre is unstable and at $\leq$10 calibers distance liquid stalling in flow centre may be observed. 7 refs.; 7 figs.

1289 **(FEI—1881) Some peculiarities of hydrodynamics and heat transfer in dense bundles of flow-twisting rods.** Lozhkin, V.V.; Yarkin, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. 21p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704445/JAW.

A model of liquid flow in channel with tight bunches of heated spiral strings is proposed. Proceding from the peculiarities of a boundary layer complying with this flow model engineering recommendations allowing one to process the available experimental material concerning heat and mass transfer in these channels are obtained. A principle possibility of generalizing the results obtained to the channels with tight bunches of spirally ribbed round rods is demonstrated. 16 refs.; 8 figs.

1290 **(FEI—1882) Study of liquid distribution between a flow core and films in a water-air mixture flow in an annular channel.** Boltenko, Eh.A.; Pomet'ko, R.S.; Melekhin, A.M.; Panyutcheva, E.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704446/JAW.

Results of experimental investigation into liquid distribution between the flow core and near-wall films in a 16x13.5 mm annular channel under water-air mixture flow are presented. Experiments are conducted under P=0.2 MPa, rhoW=150-250 kg/m/sup 2/s. Flowrate was measured using a slot chamber. 5 refs.; 5 figs.

1291 **(FRNC-TH—2818) Theoretical experimental study of heat and mass transfer in a condensing incompressible boundary layer on a flat plane.** Legay-Desesquelles, F. (Paris-6 Univ., 75 (France)). 1984. 97p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755307/JAW.

In order to improve the performances of heat exchangers, the heat flux at the surface of the exchanging plate with a mixed flow composed of saturated air and water vapour flowing on a cooled horizontal surface, is studied. The water vapour is condensed and latent heat is released in the boundary layer. The heat flux is thus notably increased. The emphasis is given on low temperature differences and moderate heat exchange levels. Two cases are studied: laminar and turbulent boundary layers.

1292 **(FRNC-TH—2844) Determination of heat exchange coefficients using a pulse method.** Massaad, A. (Lyon-1 Univ., 69 - Villeurbanne (France)). 1985. 160p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755306/JAW.

An experimental method for the determination of the heat exchange rate between a fluid and a wall in pulsed mode (transient state) is described. The method is based on the evaluation of the fluid and wall temperatures and of the flux densities leaving the wall. The measures are performed, in transient state, from the cooling of the wall, and in steady state, from the dissipated joule energy.

1293 **(INIS-BR—1284) Experimental determination of a fluid local velocity noise analysis of temperature fluctuations.** Foucrier, M.J. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. 74p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704527/JAW.

Noise analysis of temperature fluctuations is employed to determine the average fluid velocity in turbulent flow. Temperature signals of sensors separated by a Known distance are read and cross-correlated in order to obtain the time delay between the sensors. Several parameters are varied in order to determine their influence on the results and trends. It is shown that the techniques can yield accurate results with deviations better than 5% relative to a standard measurement.

1294 **(KFK—4408) Velocity and turbulence distributions in wall subchannels of a rod bundle in three axial planes immediately downstream of a spacer grid.** Rehme, K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jun 1988. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755420/JAW.

Measurements of the mean velocity, of the wall shear stresses, and of the turbulence have been performed in two wall subchannels (P/D=1.223; W/D=1.183) of a rod bundle of four parallel rods arranged in a rectangular channel for three axial planes. A spacer grid of the SNR-type was inserted in the rod bundle at ratios of distance between the spacer grid and the measuring plane and the hydraulic diameter of L/D/sub h/=0.96, 0.49 and 0.25, respectively. The Reynolds number of this investigation was Re=1.55.10/sup 5/. The results show that the distributions of the velocity and of the turbulence are completed governed by the spacer grid. The effects of the spacer grid increase with decreasing distance from the spacer grid.

1295 **(LA—11384-MS) Small ASM probes.** Fritz, J.N.; Olinger, B.; Vorthman, J.E.; Wilder, L. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 21p. NTIS, PC A03/MF A01. Order Number DE89002096/JAW.

A part of the ongoing effort to miniaturize the adjoint sensitivity method (ASM) probe, six small probes in different configurations were tested on a single experiment. The results of the different configurations are presented. The ASM probe is quite accurate and its performance is well understood in those situations where we have a relatively large area that has 1-D flow. Area is expensive and it is desirable to make measurements using a minimum of this resource. When we confine ourselves to a small area we get electromagnetic effects and perturbations in the hydrodynamic flows that were absent in experiments whose lateral extent was large enough to effectively eliminate these problems. We are forced toward magnet and coil configurations that are not ideal for best accuracy. In the experiment described in this report, we describe and report the results of six ASM probes that approach the goal of using less area. 2 refs., 23 figs., 2 tabs.

1296 **(N—88-23956) Effects of inlet turbulence and rotor/stator interactions on the aerodynamics and heat transfer of a large-scale rotating turbine model. Part 4: Aerodynamic data tabulation.** Dring, R.P.; Joslyn, H.D.; Blair, M.F. (United Technologies Research Center, East Hartford, CT (USA)). Nov 1987. 135p. (NASA-CR—179469; NAS—1.26:179469; UTRC-R—86-956480-4). NTIS, PC A07/MF A01.

A combined experimental and analytical program was conducted to examine the effects of inlet turbulence and airfoil heat transfer. The experimental portion of the study was conducted in a large-scale (approx. 5X engine), ambient temperature, rotating turbine model configured in both single-stage and stage-and-a-half arrangements. Heat transfer measurements were obtained using low-conductivity air foils with miniature thermocouples welded to a thin, electrically heated surface skin. Heat transfer data were acquired for various combinations of low or high inlet turbulence intensity, flow coefficient, first stator-rotor axial spacing, Reynolds number and relative circumferential position of the first and second stators. Aerodynamic measurements obtained include distributions of the mean and fluctuating velocities at the turbine inlet and, for each airfoil row, midspan airfoil surface pressures and circumferential distributions of the downstream steady state pressures and fluctuating velocities. Results include airfoil heat transfer predictions produced using existing 2-D boundary layer computation schemes and an examination of solutions of the unsteady boundary layer equations.

1297 **(N—88-24001) Application of integrated fluid-thermal-structural analysis methods.** Wieting, A.R.; Dechaumphai, P.; Bey, K.S.; Thornton, E.A.; Morgan, K. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). May 1988. 13p. (NASA-TM—100625; NAS—1.15:100625; CONF-8808144—). NTIS, PC A03/MF A01.

From 16. congress of the International Council of the Aeronautical Sciences; Jerusalem, Israel (28 Aug 1988).

Hypersonic vehicles operate in a hostile aerothermal environment which has a significant impact on their aerothermostructural performance. Significant coupling occurs between the aerodynamic flow field, structural heat transfer, and structural response creating a multidisciplinary interaction. Interfacing state-of-the-art disciplinary analysis methods is not efficient, hence interdisciplinary analysis methods integrated into a single aerothermostructural analyzer are needed. The NASA Langley Research Center is developing such methods in an analyzer called LIFTS (Langley Integrated Fluid-Thermal-Structural) analyzer. The evolution and status of LIFTS is reviewed and illustrated through applications.

1298 **(N—88-24754) Arc-textured metal surfaces for high thermal emittance space radiators.** Banks, B.A.; Rutledge, S.K.; Mirtich, M.J.; Behrend, T.; Hotes, D.; Kussmaul, M.; Barry, J.; Stidham, C.; Stueber, T.; Difilippo, F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 11p. (NASA-TM—100894; E—4135; NAS—1.15:100894; CONF-880488—). NTIS, PC A03/MF A01.

From 15. international conference on metallurgical coatings; San Diego, CA, USA (11 Apr 1988).

Carbon arc electrical discharges struck across the surfaces of metals such as Nb-1 percent Zr, alter the morphology to produce a high thermal emittance surface. Metal from the surface and carbon from the arc electrode vaporize during arcing, and then condense on the metal surface to produce a microscopically rough surface having a high thermal emittance. Quantitative spectral reflectance measurements from 0.33 to 15 microns were made on metal surfaces which were carbon arc treated in an inert gas environment. The resulting spectral reflectance data were then used to calculate thermal emittance as a function of temperature for various methods of arc treatment. The results of arc treatment on various metals are presented for both ac and dc arcs. Surface characterization data, including thermal emittance as a function of temperature, scanning electron microscopy, and atomic oxygen durability, are also presented. The ac arc texturing was found to increase the thermal emittance at 800 K from 0.05 to 0.70.

1299 **(N—88-25477) Moving belt radiator development status.** White, K.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1988. 24p. (NASA-TM—100909; E—4140; NAS—1.15:100909; CONF-880702—). NTIS, PC A03/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

Development of the Moving Belt Radiator (MBR) as an advanced space radiator concept is discussed. The ralative merits of Solid Belt (SBR), Liquid Belt (LBR), and Hybrid Belt (HBR) Radiators are described. Analytical and experimental efforts related to the dynamics of a rotating belt in microgravity are reviewed. The development of methods for transferring heat to the moving belt is discussed, and the results from several experimental investigations are summarized. Limited efforts related to the belt deployment and stowage, and to fabrication of a hybrid belt, are also discussed. Life limiting factors such as seal wear and micrometeroid resistance are identified. The results from various MBR point design studies for several power levels are compared with advanced Heat Pipe Radiator technology. MBR designs are shown to compare favorable at both 300 and 1000 K temperature levels. However, additional effort will be required to resolve critical technology issues and to demonstrate the advantage of MBR systems.

1300 **(N—88-25854) Solution of the Elrod algorithm for a dynamically loaded journal bearing using multigrid techniques.** Woods, C.M.; Brewe, D.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 31p. (NASA-TM—100941; E—4222; NAS—1.15:100941; AVSCOM-TR—88-C-006; CONF-8810213—). NTIS, PC A03/MF A01.

From Tribology conference; Baltimore, MD, USA (16 Oct 1988).

A numerical solution to a theoretical model of vapor cavitation in a dynamically loaded journal bearing is developed utilizing a multigrid iteration technique. The method is compared with a noniterative approach in terms of computational time and accuracy. The computational model is based on the Elrod algorithm, a control volume approach to the Reynolds equation which mimics the Jakobsson-Floberg and Olsson cavitation theory. Besides accounting for a moving cavitation boundary and conservation of mass at the boundary, it also conserves mass within the cavitated region via a smeared mass or striated flow extending to both surfaces in the film gap. The mixed nature of the equations (parabolic in the full film zone and hyperbolic in the cavitated zone) coupled with the dynamic aspects of the problem create interesting difficulties for the present solution approach. Emphasis is placed on the methods found to eliminate solution instabilities. Excellent results are obtained for both accuracy and reduction of computational time.

1301 **(N—88-25856) Navier-Stokes solver for cascade flows. Final report.** Arnone, A.; Swanson, R.C. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1988. 29p. (NASA-CR—181682; ICASE—88-32; NAS—1.26:181682). NTIS, PC A03/MF A01.

A computer code for solving the Reynolds averaged full Navier-Stokes equations has been developed and applied using sheared H-type grids. The Baldwin-Lomax eddy-viscosity model is used for turbulence closure. The integration in time is based on an explicit four-stage Runge-Kutta scheme. Local time stepping, variable coefficient implicit residual smoothing, and a full multigrid method have been implemented to accelerate steady state calculations. Comparisons with experimental data show that the code is an accurate viscous solver and can give very good blade-to-blade predictions for engineering applications in less than 100 multigrid cycles on the finest mesh.

1302 **(N—88-26619) Improved 3-D turbomachinery CFD algorithm. Final report, 1 November 1986-15 May 1988.** Janus, J.M.; Whitfield, D.L. (Mississippi State Univ., Mississippi State (USA)). Jun 1988. 56p. (NASA-CR—179364; NAS—1.26:179364). NTIS, PC A04/MF A01.

The building blocks of a computer algorithm developed for the time-accurate flow analysis of rotating machines are described. The flow model is a finite volume method utilizing a high resolution approximate Riemann solver for interface flux definitions. This block LU implicit numerical scheme possesses apparent unconditional stability. Multi-block composite gridding is used to orderly partition the field into a specified arrangement. Block interfaces, including dynamic interfaces, are treated such as to mimic interior block communication. Special attention is given to the reduction of in-core memory requirements by placing the burden on secondary storage media. Broad applicability is implied, although the results presented are restricted to that of an even blade count configuration. Several other configurations are presently under investigation, the results of which will appear in subsequent publications.

1303 **(N—88-26732) Design and fabrication of a Stirling engine heat exchanger module with an integral heat pipe.** Schreiber, J.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. 11p. (NASA-TM—101296; E—4101; NAS—1.15:101296; CONF-880702—). NTIS, PC A03/MF A01.

From 23. intersociety energy conversion engineering conference; Denver, CO, USA (31 Jul 1988).

The conceptual design of a free-piston Stirling Space Engine (SSE) intended for space power applications has been generated. The engine was designed to produce 25 kW of electric power with heat supplied by a nuclear reactor. A novel heat exchanger module was designed to reduce the number of critical joints in the heat exchanger assembly while also incorporating a heat pipe as the link between the engine and the heat source. Two inexpensive verification tests are proposed. The SSE heat exchanger module is described and the operating conditions for the module are outlined. The design process of the heat exchanger modules, including the sodium heat pipe, is briefly described. Similarities between the proposed SSE heat exchanger modules and the LeRC test modules for two test engines are presented. The benefits and weaknesses of using a sodium heat pipe to transport heat to a Stirling engine are discussed. Similarly, the problems encountered when using a true heat pipe, as opposed to a more simple reflux boiler, are described. The instruments incorporated into the modules and the test program are also outlined.

1304 **(NP—9770083) Studies on separation systems for saturated steam drying.** Wuschek, M. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 10 Jul 1987. 147p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE89770083/JAW.

Several types of separators were investigated, some of them with calculation models. Deflection separators and droplet washout are discussed theoretically. The experimental set-up and conditions are described, and the results obtained are discussed. The design and operation of deflection separators are gone into, and improvements in the overall system of washer plus separator are proposed. (HAG).

1305 **(NP—9770084) Contribution to flow calculation in turbomachines using the finite element method.** Loetzerich, M. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 10 Jul 1987. 130p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE89770084/JAW.

The finite element method is described, and its applicability for flow calculations in turbomachines is discussed. Examples are presented for determining the accuracy of methods based on the current function equation. The limitations of the flow surface model are pointed out. A FE algorithm for hyperbolic problems is presented and used for solving the Navier-Stokes equation. The results are analyzed, and the advantages and shortcomings of a calculation on restructured networks are discussed. (HAG).

1306 **(PB—88-235361/XAB) Modeling of rapid direct-contact condensation. Report on phase 1 (Final).** Wallis, G.B.; Richter, H.J.; Valenzuela, J.A.; Rothe, P.H. (Creare, Inc., Hanover, NH (USA)). Aug 1985. 33p. (CREARE-TM—1030). NTIS, PC A03/MF A01.

The focus of the study is on rapid direct-contact condensation phenomena, that is, direct-contact condensation situations characterized by extremely high condensation rates and violent mixing at the liquid-vapor interface. Rapid condensation phenomena arise in many industrial processes, but general methods do not presently exist to design effective components or to avoid system-flow instability. A conceptual model and preliminary analysis of rapid condensation are presented, and preliminary, proof-of-concept experiments are described. Some background information and a brief survey of previous work in the area are also provided.

1307 **(PB—88-247465/XAB) EHD (electrohydrodynamics) enhancement of heat transfer in heat exchangers. Annual report, June 1987-May 1988.** Nelson, D.A.; Ohadi, M.M. (Michigan Technological Univ., Houghton (USA). Dept. of Mechanical Engineering and Engineering Mechanics). Aug 1988. 51p. NTIS, PC A04/MF A01.

The potential of using an electric field with negligible power consumption (the corona discharge) to enhance corrective heat-transfer coefficients for air flow in straight tubes was investigated experimentally. Pressure-drop and heat transfer measurements were performed for Reynolds numbers ranging from ReD = 1000 to ReD = 20,000 and for electrode potentials from 6.5 (the approximate corona threshold) to 7.75 kv (just below the spark-over potential). The effects were studied in the presence of both negative and positive corona fields. Based on the results obtained, a maximum of 215% enhancement in heat-transfer coefficients at Reynolds number of Re subscript D = 2000 and at field potential of 0 = 7.75 kv was obtained. The maximum rise in friction factors was 260 and it occurred under the conditions for which heat transfer was maximum (i.e., Re subscript D = 2000, 0 = 7.75 kv). The technique was found most effective at moderate Reynolds numbers and at the highest electrode potential. A heat-transfer enhancement for 40% with only 12% increase in pressure drops was obtained at Te subscript D = 5000 and 0 = 7.75 kv.

1308 **(PIRSEM—2029) Thermal conductivity of molten salts mixtures for industrial applications.** Le Neindre, B. (Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM)). 1986. 27p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755311/JAW.

A new method for the measurement of the thermal conductivity of molten salts mixtures used for heat transfers or thermal storage is presented. It is based on coaxial cylinders with a very small interface in order to minimize the radiative correction. The measuring precision is evaluated at 4 pc. In the temperature range prospected, it appears that the thermal conductivity is independ of temperature; the thermal conductivity may thus be calculated with a simple linear mixture law.

1309 **High effectiveness contour matching contact heat exchanger.** Blakely, R.L.; Roebelen, G.J. Jr.; Davenport, A.K.; Hartland, E. (to National Aeronautics and Space Administration, Washington, DC). US Patent 4,762,173. 9 Aug 1988. Filed date 19 Dec 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A high effectiveness contour matching contact heat exchanger is described having substantial manufacturing and physical distortion tolerance, comprising: (a) opposing shell members, (b) heat transfer pins extending between the shell members, each pin having a base and an outer end opposite the base, and each of the pins being attached at its respective base to a predetermined one of the shell members, and (c) means forming a close fitting receptacle for receiving the portion of each pin at the outer end thereof in the opposing shell member and closely contacting the sides of each pin thereat while providing for relative movement between each pin and its corresponding receptacle, for efficiently transfering heat between the pins and the shell members notwithstanding variations in the inter-shell spacing as much as substantially the depth of the receptacles.

1310 **(N—88-25858) Ammonia boiling in long tubes. Heat transfer and charge loss in vertical and horizontal tubes.** Malek, A.; Colin, R. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1988. Translation of Ebullition de lAmmoniac en Tube Long. Transfert de Chaleur et Pertes de Charges en Tubes Vertical et Horizontal, Senlis (France), p 1-65. (NASA-TT—20313; NAS—1.77:20313; CETIM—14-C-011). 68p. NTIS, PC A04/MF A01.

Heat exchange and charge loss inside tubes carrying boiling ammonia, such as those found in nuclear power stations, were studied in the temperature range from 30 to 70 C. Mass flow, thermal load, and saturation pressure were investigated. For charge loss during two phase flow, an expression for the weight of a liquid-vapor mix column agrees with the experiments. Flow rate is not significant in either vertical or horizontal pipes.

1311 **A comparison of two efficient nonlinear heat conduction methodologies using a two-dimensional time-dependent benchmark problem.** Wilson, G.L.; Rydin, R.A.; Orivuori, S. (Univ. of Virginia, Dept. of Nuclear Engineering and Engineering Physics, Charlottesville, VA (US)). *Nuclear Technology;* **82**: No. 1, 94-105(Jul 1988).

Two highly efficient nonlinear time-dependent heat conduction methodologies, the nonlinear time-dependent nodal integral technique (NTDNT) and IVOHEAT are compared using one- and two-dimensional time-dependent benchmark problems. The NTDNT is completely based on newly developed time-dependent nodal integral methods, whereas IVOHEAT is based on finite elements in space and Crank-Nicholson finite differences in time. IVOHEAT contains the geometric flexibility of the finite element approach, whereas the nodal integral method is constrained at present to Cartesian geometry. For test problems where both methods are equally applicable, the nodal integral method is approximately six times more efficient per dimension than IVOHEAT when a comparable overall accuracy is chosen. This translates to a factor of 200 for a three-dimensional problem having relatively homogeneous regions, and to a smaller advantage as the degree of heterogeneity increases.

1312 **Sensitivity analysis of two-phase flow problems.** Toomarian, N.; Wacholder, E.; Kaizerman, S. (Oak Ridge National Lab., Center for Engineering Systems Advanced Research Engineering Physics and Mathematics Div., Oak Ridge, TN (US)). *Nuclear Science and Engineering;* **99**: No. 1, 53-81(May 1988).

The mathematical derivation and application of two deterministic sensitivity analysis methods, the direct approach of sensitivity (DAS) and the adjoint sensitivity method (ASM), are presented for two-phase flow problems. The physical problems investigated are formulated by the transient one-dimensional two-phase flow diffusion model, which consists of a system of four coupled quasi-linear first-order partial differential equations. The DAS method provides the sensitivity coefficients of all primary dependent variables at each time and space location with respect to a single input parameter. On the other hand, the ASM provides the sensitivity coefficients of a single response function at a specified time and space location with respect to all input parameters.

1313 **Acoustically enhanced heat exchange and drying apparatus.** Bramlette, T.T.; Keller, J.O. US Patent Application 6-071,953. 10 Jul 1987. 34p. Contract AC04-76DP00789. NTIS, PC A03/MF A01.

A heat transfer drying apparatus includes an acoustically augmented heat transfer chamber for receiving material to be dried. The chamber includes a first heat transfer gas inlet, a second heat transfer gas inlet, a material inlet, and a gas outlet which also serves as a dried material and gas outlet. A non-pulsing first heat transfer gas source provides a first drying gas to the acoustically augmented heat transfer chamber through the first heat transfer gas inlet. A valveless, continuous second heat transfer gas source provides a second drying gas to the acoustically augmented heat transfer chamber through the second heat transfer gas inlet. The second drying gas also generates acoustic waves which bring about acoustical coupling with the gases in the acoustically augmented heat

transfer chamber. The second drying gas itself oscillates at an acoustic frequency of approximately 180 Hz due to fluid mechanical motion in the gas. The oscillations of the second heat transfer gas coupled to the first heat transfer gas in the acoustically augmented heat transfer chamber enhance heat and mass transfer by convection within the chamber. 3 figs.

4205 Materials Testing

REFER ALSO TO CITATION(S) 322, 550, 552, 611, 613, 614, 716, 883, 893, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 957, 959, 960, 961, 962, 963, 964, 967, 968, 969, 970, 971, 972, 973, 974, 975, 989, 1052, 1053, 1054, 1055, 1056, 1120, 1121, 1122, 1123, 1124, 1126, 1128, 1129, 1130, 1132, 1133, 1134, 1135, 1136, 1139, 1143, 1147, 1148, 1149, 1150, 1151, 1591, 1596

1314 **(AGARD-R—751) Automated measurement of crack length and load line displacement of elevated temperature.** Vanleeuwen, H.P.; Groep, F.F.; Schra, L.; Dam, N. (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Feb 1988. 14p. (CONF-8710398—). NTIS, PC A03/MF A01.

From 65. meeting of the Structures and Materials Panel of AGARD; Cesme, Turkey (4 Oct 1987).

Test results reported in the literature show that in creep cracking tests at elevated temperature under steady load, the crack growth rate correlates best with the contour integral C* (also called J*) in comparison to other possible parameters. In the case of the fatigue at elevated temperature, the crack growth rate correlates best with C* if cracking is predominantly time dependent. If, however, cracking is predominantly cycle dependent the crack growth rate correlates best with the range Delta J of the contour integral J. It is discussed that in such testing C* and J are fairly easily determined if, apart from load and crack length, the load line displacement is measured. A description is given of a test setup developed for elevated temperature creep cracking tests in which crack length was measured with the electrical potential drop method and load line displacement measured with two inductive transducers located inside the furnace. Measurement was automated with the aid of a personal computer which controlled the measurements and processed the results automatically. This setup can be adapted for elevated temperature fatigue testing.

1315 **(PB—88-235312/XAB) Flaw inspection in nonferrous conductors using magneto-optic detection methods. Final report.** Fitzpatrick, G.L. (Sigma Research, Inc., Redmond, WA (USA). Seattle Div.). Nov 1985. 58p. NTIS, PC A04/MF A01.

A new method was used to accomplish direct visualization of flaws in nonferrous materials, using magnetic garnet films as detectors of magnetic fields associated with eddy currents. By illuminating such films with plane polarized light and using a polarizing analyzer, the magnetic domain structure of the film can be made directly visible. Since the domains are altered by magnetic fields associated with eddy currents perturbed by flaws, a method of direct visualization of flaws may be achieved. A special uniaxially anisotropic garnet film was acquired and the researchers tested the response of the film to time varying magnetic fields, designed an imaging experiment, and produced a variety of eddy-current images. Flaws in aluminum were imaged at 30 KHz (skin depth approximately .025 in). Although currents were not as high as desired, good images were obtained, demonstrating basic feasibility.

1316 **(RISO-M—2732) Examination of fibre composites by ultrasound for defect inspection and determination of material properties.** Gundtoft, H.E. (Risoe National Lab., Roskilde (Denmark)). Jul 1988. 16p. (CONF-8806256—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755067/JAW.

From Danish - Israeli symposium on non destructive evaluation; Copenhagen, Denmark (27 Jun 1988).

Fibre composites may be produced by stacking prepregs impregnated with epoxy and hardening those in an autoclave. Results from different non destructive ultrasonic methods used on this product are presented. Two techiques (double through transmission and reflector) are developed from C-scan. They are useful for finding delaminations and porosities. An attempt was made to determine the porosity content in the plates non destructively with the reflector techique. A third technique (called "in plane transmission") is a contact method with separated transmitter and receiver on the same side of the plate (50 mm apart). The wave form of the received signal is digitized, and several so-called "stress wave factors" are calculated from the digitized values. The sound velocity is also calculated. Measurement has been made on materials in different thicknesses and with variation in fibre orientation and fibre material. Results from scanning with the reflector technique and in plane transmission measurement on the same samples are compared. 15 ills.

1317 **(SAND—88-2536C) Hypervelocity impact and lethality: Experiment, theory, computation.** Grady, D.E.; Trucano, T.G.; McGlaun, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-8810183—1). NTIS, PC A03/MF A01. Order Number DE89001443/JAW.

From 39. Aeroballistics Range Association meeting; Albuquerque, NM, USA (10 Oct 1988).

A study directed at experimental, theoretical and computational issues in hypervelocity impact and lethality phenomena is described. The work is in progress. A series of lead-on-lead impact experiments has provided the focus for testing theoretical and computational capabilities. 9 refs., 6 figs.

1318 **(SAND—88-2786C) Gun-barrel gouging by sliding metal contact at very high velocities.** Barker, L.M.; Trucano, T.G.; Susoeff, A.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-8810183—2). NTIS, PC A03/MF A01. Order Number DE89001442/JAW.

From 39. Aeroballistics Range Association meeting; Albuquerque, NM, USA (10 Oct 1988).

A description is given of a recently resolved mechanism of gouging which occurs during hypervelocity sliding contact between two materials. A parameter study based on computer modeling of the gouging mechanism is presented in which gouging velocity thresholds are determined for several combinations of sliding materials. Materials which can gouge each other are found to do so only within a certain range of velocities. Related calculations of gaseous material ahead of hypervelocity projectiles are also presented. 11 refs., 7 figs., 2 tabs.

1319 **(UCRL—21112) A critical review of residual stress technology.** Shackelford, J.F.; Brown, B.D. (Lawrence Livermore National Lab., CA (USA)). 30 Sep 1987. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01. Order Number DE89001534/JAW.

The current technology for evaluating residual in materials has been critically reviewed from the perspective of LLNL needs. The primary technique available continues to be x-ray diffraction (XRD). Substantial analytical and experimental refinements have been made in the past decade. An especially promising development in XRD is the use of energy dispersive spectroscopy for evaluating triaxial stress. This would provide an alternative to neutron diffraction, a technique limited to a relatively small number of outside laboratories. Recent research in residual stress measurement using ultrasonics have concentrated on shear wave techniques. Substantial progress has been made in the use of electromagnetic acoustic transducers (EMAT's), surface waves, corrections for texture, and, of special interest to LLNL, the ability to characterize interfacial stress. Strain gages and related technologies continue to be actively used in field measurements of residual stress, although there is generally some destructive nature to those techniques. An increased use of multiple technique approaches to residual stress evaluation is occurring for the purposes of both verification and complementary measurements. Among a number of miscellaneous techniques found in the recent literature are several involving the use of stress-sensitive magnetic properties and an especially promising use of the thermoelastic effect for noncontact stress mapping. Recommendations for LLNL activity include energy dispersive XRD, ultrasonics characterization of anisotropy and interfacial stress, and investigation of the thermoelastic effect. 57 refs.

1320 **(Y/Sub—84-89622/1) Ultrasonic NDE of Kevlar-epoxy filament wound spherical pressure vessels.** Blake, R.A.; Steiner, K.V. (Oak Ridge Y-12 Plant, TN (USA); Delaware Univ., Newark (USA). Coll. of Engineering). Oct 1985. Contract AC05-84OS21400. 45p. NTIS, PC A03/MF A01. Order Number DE89001876/JAW.

The nondestructive evaluation of Kevlar-epoxy filament wound spherical composite pressure vessels is performed through the use of a six axis rotatorially articulated robotic manipulator. Ultrasonic pulse-echo techniques are employed to form C-scan images based upon amplitude and attenuation data gathered by a 68000 based microcomputer system. The data are imaged in planar and three dimensional forms and are further enhanced and analyzed through image processing techniques specifically developed for the analysis of complex composite structures. 25 figs.

1321 **Atomic view of solid surfaces.** Ehrlich, G. (Univ. of Illinois, Urbana (USA)). pp 1-13 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Techniques are briefly surveyed for depicting the structure and composition of surfaces on the atomic level. These include atomic microscopic methods, such as projection, field ion, and scanning tunneling microscopy, and experimental methods on individual atoms such as surface diffusion. Materials on which these techniques are illustrated include iridium, rhenium, tungsten, uranium, and gold. Resolution expectations for the various techniques are compared and future developments are assessed.

1322 **Beam-to-mode conversion of a high frequency Gaussian P-wave input in an elastic plate embedded in vacuum.** Lu, I.T.; Felsen, L.B.; Klosner, J.M. (Polytechnic Univ., Farmingdale, NY (USA)). pp 57-62 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Using the complex source point method the mechanism was explored by which an incident well collimated beam excites the spectrum of guided modes that can be supported in a layered structure. A single elastic plate embedded in vacuum was chosen. Results for the P and SV potentials in successive cross sections were computed by the beam tracking algorithm and by normal mode expression. Results for these cross sections, where the field initially resembles a beam and after successive reflections has become blurred to the point that any resemblance to a beam has disappeared and the wave pattern become oscillatory, suggests the use of a hybrid ray-mode algorithm which can be structured to encompass automatically the transition from one good observable parametrization to the other.

1323 **Influence of fiber orientation on leaky waves in composite plates.** Chimenti, D.E.; Nayfeh, A.H. (Wright-Patterson Air Force Base, Dayton, OH (USA)). pp 63-70 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Experimental and theoretical data are given for the interaction of ultrasonic waves with generally orthotropic elastic plates immersed in liquid. The theoretical analysis was based on an exact two-dimensional wave-mechanical calculation of the amplitude of the reflected and transmitted partial waves. The incidence plane of the acoustic wave makes an arbitrary angle with respect to the material symmetry axis which results in the coupling of vertical and horizontal quasitransverse waves in the plates. Highly complex refraction behavior, expressed in terms of velocity dispersion, was observed in the model. Comparisons were made to experimental ultrasonic reflection measurements on a plate of T300/Ciba-Geigy 914 composite. Results are evaluated for both transverse isotropy and orthotropic symmetry.

1324 **Acoustic scattering by elastic solids using the boundary element method.** Goswami, P.; Rizzo, F.J.; Shippy, D.J. (Iowa State Univ., Ames (USA)). pp 95-102 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Problems are addressed involving scattering of time-harmonic acoustic waves by finite solid elastic obstacles suspended in a fluid medium. A numerical method was developed using a boundary integral equation formulation to quantitatively describe the scattering process in the frequency domain. A boundary element method was used to solve the boundary integral equations. A fortran program (FS3D) was written based on this approach. Results from the simulation were compared with some existing farfield results for a scattering problem using a brass sphere in water and glycerine. A modified version of the program was also used to solve a radiation problem and the results were compared with an analytical solution.

1325 **3-D ultrasonic scattering from planar cracks by the boundary element method.** Budreck, D.E.; Achenbach, J.D. (Northwestern Univ., Evanston, IL (USA)). pp 103-111 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The boundary integral equation (BIE) method proposed by the authors in an earlier paper addressed scattering from internal penny-shaped and elliptical cracks in the frequency domain and was solved for normal incidence of an L-wave at intermediate and short wavelengths. In this paper the BIE code was used to solve for scattering by cracks of the same kind insonified by dual T-wave fields incident under 45° angles. This solution was used to construct an approximate solution to the problem of scattering from a surface-breaking crack perpendicular to the free surface and insonified by a single T-wave field incident under a 45° angle.

1326 **Role of coherent backscattering in quantitative NDE.** Nagy, P.B.; Adler, L. (Ohio State Univ., Columbus (USA)). pp 113-122 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Random signals scattered from weak material inhomogeneities can exhibit slight spatial coherency. The coherency can be caused by the measuring equipment used or induced by the properties of the material being evaluated. Both cases are demonstrated and assessed using base metal and weld samples of stainless steel 304L, a unidirectional fiber-reinforced composite plate, and copper in polycrystal form. Backscattering waveforms and power spectra were calculated by computer simulation. Data reduction and signal processing methods involving Fourier analysis and spatial averaging for discriminating between the two proposed sources of coherence were assessed.

1327 **Wave scattering by rough surfaces.** Ogilvy, J.A. (Harwell Lab., Didcot (England)). pp 123-130 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The effects of defect surface roughness on ultrasonic wave amplitudes, pulse shape change, and frequency content was studied using computer simulation. Rough surfaces were generated using a set of random but correlated data to represent the heights of a corrugated rough surface away from the mean plane. Acoustic Kirchhoff theory was then used to evaluate scattering from these surfaces. The increasing spread of energy into a diffuse field was depicted and signal amplitudes were predicted. Extension of this work to time dependent theory showed the lengthening of pulses in the

diffuse field, the loss of high frequencies in the specular field, and the narrower spread of likely signal amplitudes than for monochromatic wave theory.

1328 **Application of ultrasonic scattering modeling to a periodically rough surface.** Ng, K.W.; Ngoc, T.D.K. (Georgetown Univ., Washington, DC (USA)). pp 131-137 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The performance of key scattering models relevant to ultrasonic nondestructive evaluation is assessed. Emphasis is given to the Small Perturbation Method in the limiting case where the acoustic wavelength approaches the values of the rms roughness height and the roughness correlation length. A periodically rough surface was chosen for the experiment to eliminate uncertainties associated with the stochastic characterization of a randomly rough surface. This allowed the performance of the model to be determined strictly on the basis of known roughness and ultrasonic parameters. The angular position of the scattering peaks was mainly determined by the spacing of the roughness features while the scattering amplitude was influenced strongly by the roughness depth. The performance of the Kirchoff approximation is also evaluated.

1329 **Scattering response of voids - a second order asymptotic theory.** Chen, J.; Schmerr, L.W. Jr. (Iowa State Univ., Ames (USA)). pp 139-145 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results for a second order asymptotic theory for void sizing are discussed. The theory provides a high frequency approximate solution to the scattering of elastic waves from a volumetric flaw by using elastodynamic ray theory where the governing equations and boundary conditions are satisfied by an asymptotic series whose variables include the elastic displacement, the circular frequency, and the eikonal function. A modified 1-D sizing algorithm using the theory is given and results are cited for equivalent flaw sizing using the leading edge response. The utilization of wave polarization as a source of additional scattering and sizing information is evaluated.

1330 **Progress in uniform field eddy current methods.** Moulder, J.C.; Nakagawa, N.; Shull, P.J. (Iowa State Univ., Ames (USA)). pp 147-155 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Two concerns identified earlier in using the uniform field eddy current method were addressed. These concerns are 1) uncertainty regarding the calibration formula that was used and 2) some cases where the inversion method underestimated crack depth. In this paper the calibration formula was rederived using a different approach. The new formula agreed with experimental data. It was also shown that a shallow and wide cylindrical recess in a high conductivity material yielded the most accurate calibration. The effect of crack closure on flaw signals was studied with a new two-dimensional model developed by Nakagawa et al. It was also demonstrated that crack closure occurrence can be detected by large deviations in the flaw signal phase away from 90 degrees. Ti-6Al-4V alloy served as a test material.

1331 **Remote-field eddy current testing: a review.** Palanisamy, R. (Timken Co., Canton, OH (USA)). pp 157-164 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The remote-field eddy current technique is reviewed from its origins in the 1950s through its commercial utilization in the 1960s for the in situ inspection of oil well casings to research currently being conducted to expand its applications. The advantages and disadvantages of the method are outlined and evaluated. The development of theoretical modeling techniques, both analytical and numerical, is discussed. Graphs depicting electromagnetic field measurements on well casings and a block diagram of the casing inspection tool are included along with a casing remote field representation. Applications such as the nondestructive evaluation of carbon steel tubing in power steam generators, small diameter heat exchangers, and gas distribution pipes are mentioned.

1332 **Physics of the remote field eddy current effect.** Lord, W.; Sun, Y.S.; Udpa, S.S.; Nath, S. (Colorado State Univ., Fort Collins (USA)). pp 165-172 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Remote field eddy current probe behavior was investigated by comparison with conventional eddy current methods. The same quasistatic forms of Maxwell's equations were used to model both probe types. The difference in probe physics, due to the sensor coil of the remote field probe operating in the very weak field from the exciter coil, was evaluated. Finite element modeling results for oil casing inspection are given which assess the skin effect phenomena associated with eddy current testing and also predict unusual potential valley and phase knot phenomena and confirm the sensitivity of remote field probes to both inside and outside diameter defects.

1333 **Study of the effect of frequency in crack depth measurement by the AC field technique.** Mirshekar-Syahkal, D.; Sadeghi, S.H.H. (Essex Univ., Colchester (England)). pp 181-189 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Initially parasitic signals associated with the probe and with the front-end amplifier during crack depth assessment using an alternating current field measurement (ACFM) technique were identified. The effects of these signals on the ACFM accuracy were examined by establishing a relationship between them and the associated error in the reading. This led to the concept of maximum error and optimum operating frequency for a system used for a particular inspection task. Tuned ACFM systems were considered in which the parasitic signals were electronically removed from the readings. Experimental verification of the theoretical analysis was made.

1334 **Thick-skin modeling for surface-breaking cracks.** Michael, D.H.; Collins, R.; Parramore, D.R.; Aldoujaily, M.; Travis, R.P. (Univ. College London (England)). pp 191-197 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Theoretical and experimental work in the analysis and modeling of thick-skin fields around surface breaking cracks is described relative to the alternating current field measurement method of nondestructive evaluation. The governing equation for the two-dimensional model of a crack interrogated by an alternating current was obtained from a classical potential barrier solution and was then generalized in the thick-skin limit. In this limit the Maxwell equations reduced to the electrostatic equations and the solutions were analogous to velocity vector solutions in incompressible irrotational hydrodynamics. The model was applied to determining current and field distributions disturbed by a half ellipsoidal surface cavity. Nimonic specimens were used for experimental data. Multipliers were determined for assessing the effects of crack aspect ratios. Modeling for edge cracks is briefly discussed.

1335 **Sound producing mechanisms in thermoacoustic microscopes.** Favro, L.D.; Shepard, S.M.; Kuo, P.K.; Thomas, R.L. (Wayne State Univ., Detroit, MI (USA)). pp 225-229 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A model for the sound generation for a periodic point source suitable to thermoacoustic microscopy source requirements was constructed and an exact solution to the thermoelastic equations with such a source was realized. The solution describes all of the thermal and elastic wave modes in the bulk and on the surface. Angular distributions for waves mode-converted from the thermal and longitudinal waves generated by a heat source are graphed along with angular distributions of longitudinal and transverse contributions to the sound field from a momentum source.

1336 **Thermal wave physics of insulating materials.** Inglehart, L.J.; Le Gal La Salle, E. (Johns Hopkins Univ., Baltimore, MD (USA)). pp 231-237 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The physics and application of thermal wave methods to the NDE of thermal insulating materials including Al, Al_2O_3, SiO_2, SiC, and Si_3N_4 are discussed. Images of distributed damage in a siliconized SiC composite material are described and a contour of the temperature profile inside a SiO_2 insulator obtained by probing the solid directly is presented. Modulation frequency and time required to penetrate a depth of 1 mm for these materials are tabulated. Contour images are included for magnitudes of the normal and transverse deflections along with line traces for the magnitude and phase of the normal deflection.

1337 **Thermomechanical contract mechanism in thermoacoustic imaging for NDE.** Ringermacher, H.I.; Bak, M. (United Technologies Research Center, East Hartford, CT (USA)). pp 239-244 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The thermomechanical contrast mechanism was verified using a finite element analysis employing a purely thermomechanical formulation. The analysis is time independent and also independent of the temperature distribution of the ingoing thermal wave. A single thermal element constant energy loading was assumed to produce the specimen mechanical response. The specimen was a square of stainless steel 304 containing a sloping EDM groove. The analysis was performed only in the thermally thick region of the groove to ensure that the calculated results could be correctly compared to the observed thermal-wave-independent data. The thermomechanical response was seen as the elastic response of a dimensionally bounded region to a thermal source load. Implications of the mechanism for mechanical NDE are assessed.

1338 **Quantitative evaluation of transient video thermography.** Allport, J.J.; McHugh, S.L. (Lockheed Research Development Div., Palo Alto, CA (USA)). pp 253-262 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

One-dimensional and quasi-two-dimensional models and associated scaling rules are provided which may be used to estimate the appearance time, contrast, and attainable resolution in surface thermal patterns produced using single-sided transient video thermography. The effectiveness of these models is illustrated by comparing them to carefully controlled transient video thermography measurements and to two-dimensional finite element calculations.

1339 **Thermal wave characterization of coated surfaces using an IR video camera and a scanned heat source.** Kuo, P.K.; Hartikainen, J.; Oppenheim, I.C.; Favro, L.D.; Feng, Z.J.; Thomas, R.L. (Wayne State Univ., Detroit, MI (USA)). pp 273-277 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Infrared video cameras make thermal wave NDE possible by means of time-dependent heating and synchronous observation of the resulting IR emission from the sample. With its fixed rate of 50 or 60 fields per second, however, the camera cannot catch fast thermal phenomena in the millisecond range when used in the conventional method of active thermography, either with a fixed area source such as a flash lamp or a scanned and unsynchronized IR source. This article presents a method which uses a focused and scanned optical laser beam synchronized with the vertical scan of the camera. It achieves imaging of much faster thermal wave phenomena, on a submillisecond time scale, and is also capable of acquiring data on an entire vertically scanned line at the video field rate.

1340 **Contrast enhancement through source impedance control in thermal NDE.** Welch, C.S. (College of William and Mary, Williamsburg, VA (USA)). pp 279-285 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

By creating a mathematical description of temperature contrast and developing the appropriate theory to describe a simple case, the thermal impedance of the observing surface was shown to be a significant factor in thermal NDE. The secondary increase in thermal contrast found in some thermal imaging data was shown, using numerical models, to be associated with modulation of the surface thermal impedance concurrently with application of the driving temperature variation. The frequency-independent nature of the surface thermal impedance reduced the surface expression of waves with sufficiently long wavelengths substantially. By considering that the wavelength of a thermal wave is associated with its exponential decay depth a formula was derived which describes the penetration depth attainable for observing thermal contrast with a given surface heat transfer coefficient.

1341 **NMR imaging of solids.** Miller, J.B.; Garroway, A.N. (Naval Research Lab., Washington, DC (USA)). pp 287-294 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Techniques are described and demonstrated for the use of nuclear magnetic resonance (NMR) to image solids and the potential uses and limitations of NMR solid imaging are evaluated. Spatial resolution and line narrowing problems are addressed and methods for removing the line broadening mechanisms are examined for the H 1 NMR imaging of organic materials. The homonuclear magnetic dipole-dipole interaction, dominant among these mechanisms, was removed by applying a sequence of resonant phase-modulated rf pulses to vary the spin system state. Line narrowing and Fourier imaging were also combined to produce two-dimensional images of solids. NMR imaging with a surface coil was explored. Test materials included epoxy, neoprene rubber, and adamantane. Comparisons are drawn with magnetic resonance imaging methods.

1342 **Removing the effects of surface roughness from acoustical images.** Reinholdtsen, P.A.; Khuri-Yakub, B.T. (Stanford Univ., CA (USA)). pp 299-308 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A low-frequency scanning acoustic microscope has been built that measures both amplitude and phase and permits two-dimensional image processing techniques to be used in ways that amplitude data alone prohibit. The angular spectra of transducers was characterized by the inversion of V(z) data which resulted in the ability to numerically defocus acoustic images and enabled surface features to be removed from experimentally defocused images. This led to greatly enhanced relative contrast between subsurface features. Acoustic image resolution was also enhanced by tailoring the spatial frequency response of the transducers and using an adapted deconvolution technique developed by Phil Hobbs. F2 transducers were used in the study to image aluminum samples and an American quarter.

1343 **Refractive focusing systems for ultrasonic imaging.** Gilmore, R.S.; Hewes, R.A.; Tam, K.C.; Trzaskos, C.R.; Young, J.D. (General Electric Co., Schenectady, NY (USA)). pp 309-318 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Most commercially available focused ultrasonic transducers are manufactured with spherical lenses which form well-defined focal zones in water but produce badly aberrant beams when coupled to higher velocity materials. This paper documents the design of transducer-buffer-rod-lens combinations which will produce diffraction-limited focal zones in high-velocity materials at specific depths. Spherical and aspherical focusing conditions and lens designs are compared and analyzed by ray-tracing calculations for their optical behavior. Effects of diffraction and of changing the inspection material on focal depth are evaluated and resolution considerations are discussed.

1344 **Ultrasonic image reconstruction utilizing a full volume digitized waveform database.** Weber, S.A.; Blake, R.A. Jr.; Irwin, R.G. Jr. (Visual Edge, Montreal, Quebec (Canada)). pp 319-324 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Two software applications were developed to evaluate ultrasonic pulse echo C-scan data. The data acquisition application controls the mechanical scanner and stores the digitized waveforms on disk. The analysis application provides the user with an interactive evaluation of the waveform database. Both programs are mouse driven with pull down menus. The 3-D reconstruction of digitized pulse-echo waveforms is well suited for full volume evaluations of composite materials. Processing the waveform database with respect to a statistical reference waveform produces excellent results over the entire range of data values. The standard deviation of the waveform database from the mean provides a method for evaluating the porosity of a composite material. Results for a graphite epoxy laminate are given.

1345 **Quantitative analysis of real-time radiographic systems.** Barker, M.D.; Condon, P.E.; Barry, R.C.; Betz, R.A.; Klynn, L.M. (Lockheed Research and Development Div., Palo Alto, CA (USA)). pp 333-341 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method was developed which yields quantitative information on the spatial resolution, contrast sensitivity, image noise, and focal spot size from real time radiographic images. The method uses simple image quality indicators and computer programs which make it possible to readily obtain quantitative performance measurements of single or multiple radiographic systems. It was used for x-ray and optical images to determine which component of the system was not operating up to standard. Focal spot size was monitored by imaging a bar pattern. This paper constitutes the second progress report on the development of the camera and radiation image quality indicators.

1346 **Three dimensional modeling of projection x-ray radiography.** Gray, J.N. (Iowa State Univ., Ames (USA)). pp 343-348 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Performance results are presented for a full three dimensional x-ray projection radiography model. The model can simulate an x-ray photograph, the generation of the x-ray beam at the source, the interaction of the beam with a sample material containing a flaw, and the effects of the beam on the film detector. The model was used to systematically study the effect on the image of a number of system parameters such as the unsharpness due to the finite extent of the x-ray source, the geometric magnification, and the exposure. The model allows parameters controlling the image quality to be studied in isolation and in tandem.

1347 **Mathematical foundations of computed tomography: an introduction to the literature.** Lewitt, R.M. (Univ. of Pennsylvania, Philadelphia (USA)). pp 367-371 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Publications which have appeared since 1980 on computer methods for image reconstruction from tomographic projections are listed and bibliographed. They include books, survey papers, conference proceedings, and special issues of journals and were selected to provide an overview of computerized tomography in the last decade. The publications represent general approaches to the formulation of algorithms for image processing using transform and series expansion methods.

1348 **Quantitative computed tomography.** Vannier, M.W.; Ellingson, W.A. (Washington Univ. Medical Center, S. Louis, MO (USA)). pp 373-380 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988).

The physical processes occurring in computed tomography and the precision of the resulting measurements were evaluated. The error sources include the unknown composition of the material under study, beam hardening effects, scattered or off-focal radiation, selection and orientation of the slice, ROI position and shape, and apparatus stability. The viability of cobalt 60, iridium 192, and cesium 137 as photon sources was assessed. Beam hardening and photon attenuation problems were analyzed and methods for correcting beam hardening were investigated. Dual energy methods for beam hardening corrections were emphasized.

1349 **Application of high magnification to 3D x-ray computed tomography.** Feldkamp, L.A.; Kubinski, D.J.; Jesion, G. (Ford Motor Co., Dearborn, MI (USA)). pp 381-388 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A system was previously described for direct three-dimensional x-ray computed tomography which embodies both a means of performing reconstruction from cone-beam projection data and a means of acquiring such data. After replacing the microfocus source the system resolution under standard conditions is now determined primarily by the spatial resolution of the x-ray image intensifier which serves as the two dimensional detector. To more fully exploit the potential of the x-ray source and to bypass the limits of the detection system the use of high geometric magnification was explored. Initial findings are presented for both a conventional full-field configuration and a configuration in which only a

limited volume of a sample can be reconstructed. The results indicate the utility of combining aspects of microradiography with those of computed tomography.

1350 **NDT for small defects by x-ray tomography.** Vontz, T.; Goebbels, K.; Maisl, M.; Reiter, H.; Hirsekorn, S. (Fraunhofer Institut fuer zerstoerungsfreie Pruefverfahren (IZfP) (West Germany)). pp 389-397 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Methods to enhance the quality of a tomograph with respect to resolution, noise, flaw detection, and artifacts are discussed. Experimental results with a medical system and examples which verify the theoretical predictions are presented along with initial results obtained with a high resolution tomography system which was developed at the institute. The dependence of contrast resolution on spatial resolution along with attenuation coefficients for flaw and crack detection in samples of aluminum disks and ceramic rotors are evaluated and graphed. Tomographs of a ceramic rotor embedded in silicon powder with an impurity and with a branched crack are included.

1351 **Model-based ultrasonic tomography.** Azevedo, S.G.; Fitch, J.P.; Thomas, G.H. (Lawrence Livermore National Lab., CA (USA)). pp 399-406 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-48.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Work in progress on ultrasonic diffraction tomography for NDE is summarized. Simulation results for known phantom parts with good ultrasonic properties and with a simple cylindrical shape are evaluated. An imaging model based on the inhomogeous Helmholtz equation and the Rytov approximation is described. Raw data for the reconstruction algorithm are time-domain signals representing averaged transmitted pulses through the object and digitized at 20 MHz. Data reduction is achieved by 1-D Fourier transform of the waveforms and proper reconstruction frequency selection. The complex data gives both the magnitude and phase information required for the Rytov approximation. Thirty projections each composed of 64 waveforms were simulated using a 1 MHz diffracted wave field. Test materials included air, water, epoxy, and plexiglas.

1352 **Application of computer-aided design approach for computer simulation of radiography and 3-D tomography.** Wang, L.; Rokhlin, S.I. (Ohio State Univ., Columbus (USA)). pp 407-414 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A powerful computer-aided design package was integrated with computer simulation programs, developed by the authors, for radiographic and 3-D tomographic evaluation of structures and parts. The initial design simulation of two 3-D objects, a tee weld and a tubular weld both containing plane defects, was performed using an interactive program for solid modeling called CATIA taken from the CAD/CAM Laboratory at Ohio State. Ray tracing simulation of the 2-D projections of the objects was then performed for film and real time radiography and was followed by 3-D computer tomography reconstruction. The database consisted of one hundred simulated 2-D projections taken from different angles. Results of the reconstruction are illustrated.

1353 **Development of a one-sided gamma ray tomography system.** Hill, D.W.; Peak, J.C. (GA Technologies Inc., San Diego, CA (USA)). pp 415-423 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

GA Technologies has constructed an experimental device which has determined the location and size of macroscopic features such as voids and steel bars in concrete structures. The device measures relative density variations along a plane perpendicular to the structure surface using the intensity of gamma radiation scattered back from the concrete. Collimation and energy discrimination are used to detect gamma rays from a Co 60 source which have undergone a single Compton scatter through a prescribed angle. Since the source and detector are mounted side by side, the system can readily locate and discriminate between voids, cracks, and inclusions. Detection limits for flaw size and depth are given. The system was also used to locate holes in a steel block.

1354 **Partial differential equations and the NDE inverse problem.** Lord, W. (Colorado State Univ., Fort Collins (USA)). pp 425-430 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Electromagnetic and ultrasonic NDE methods can be classified as elliptic, parabolic, or hyperbolic, depending on the type of partial differential equation governing the underlying physics of the energy/defect interaction. Such a classification system has significant implications for both the forward modeling problem and the defect classification or inverse problem. This paper gives a brief overview of the different NDE types and then classifies them according to their governing partial differential equations. Conclusions are then drawn concerning the types of forward and inverse modeling appropriate to each NDE type.

1355 **Three-dimensional electromagnetic inverse scattering: exact self-consistent equations.** Rose, J.H. (Iowa State Univ., Ames (USA)). pp 431-435 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The recently proposed self-consistent equation approach of Rose and Cheney was extended to three-dimensional electromagnetic inverse scattering. This approach requires the simultaneous solution of three equations: the electromagnetic wave equation, an integral equation which relates the wavefield to the scattering amplitude, and a new equation which determines the dielectric tensor from the low-frequency asymptotics of the wavefield. Possible methods are discussed for solving the self-consistent set resulting from combining these equations.

1356 **Recent advances in Born inversion (weak scatterers).** Bond, L.J.; Chaloner, C.; Wormley, S.J.; Neal, S.P.; Rose, J.H. (Univ. College of London (England)). pp 437-444 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A new methodology for the Born inversion is described. The approach does not require the explicit selection of a correct zero-of-time and is potentially robust in the face of bandwidth limitations. Both theoretical and experimental results are presented for the case of weakly scattering inclusions. Problems associated with implementing the inverse Born approximation are first discussed. The zero-of-time problem is explicitly defined in terms of scattering data and flaw radius estimates inferred from the Born inversion. Then the method is tested for spherical flaws in the weak scattering limit by estimating the radius of a polystyrene sphere in a thermoplastic from experimental measurements.

1357 **FLEX - an expert system for flaw classification and sizing.** Nugen, S.M.; Christensen, K.E.; Koo, L.; Schmerr, L.W. (Iowa State Univ., Ames (USA)). pp 445-451 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The Flaw Expert (FLEX) system under development at the Center for NDE at Iowa State is designed to characterize flaws as either crack-like or volumetric from an inspection of the ultrasonic scattering amplitudes taken from multiple look angles. FLEX currently consists of two cooperating expert systems. The Feature Processing (FEAP) system characterizes the waveforms with respect to a predefined set of features. The Flaw Processing (FLAP) system uses the presence or absence of these features to characterize the flaw with respect to type. Various features of FEAP and FLAP are described, including the inference strategy, the explanation facility, the audit trial display, and signal processing methods. The old and new versions of FLAP are comparatively tested for the case of a 200 x 400 micron oblate spheroid in titanium and a disk-shaped cavity in IN100.

1358 **Equivalent flaw sizing: a unified approach.** Schmerr, L.W. Jr.; Chiou, C.; Sedov, A. (Iowa State Univ., Ames (USA)). pp 453-459 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Equivalent flaw sizing algorithms have recently been developed for volumetric flaws by Hsu et al. based on the inverse Born approximation and by Schmerr and Sedov for cracks using the inverse Kirchhoff approximation. This paper describes how these separate algorithms were unified into a single flaw sizing algorithm which can determine the size and orientation of an isolated defect in terms of a best-fit ellipsoid for volumetric flaws or an ellipse for cracks. Results for the performance of this unified algorithm on both synthetic and experimental data are documented.

1359 **Eddy current flaw characterization in the time domain.** Nair, S.M.; Rose, J.H.; Kogan, V.G. (Iowa State Univ., Ames (USA)). pp 461-469 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Expressions were derived for time-domain responses of the field variables to a pulsed magnetic field for a metallic halfspace. Impedance perturbation caused by an inclusion with conductivity slightly different from that of the host was derived in both frequency and time domains. The domains were related to conductivity variations along the depth by means of a Laplace transform in the frequency domain and similar integral equations in the time domain. The numerical inversion of Laplace transforms is briefly discussed. A shift from conventional frequency domain to time domain simplified the computations considerably through causality.

1360 **Flexible substrate eddy current coil arrays.** Krampfner, Y.D.; Johnson, D.D. (Failure Analysis Associates, Palo Alto, CA (USA)). pp 471-478 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An alternative to eddy current mechanical probe scanning systems is the concept of employing multi-element probe arrays that are fabricated on a thin flexible substrate. A prototype system to demonstrate this concept was developed by Failure Analysis Associates. Design and performance specifications are given for the components of a planar 60-element array. The array was evaluated using a carbon steel plate with several tight surface EDM notches and a steam turbine blade to determine both its feasibility and practicality.

1361 **Model of ferrite-core probes over composite workpieces.** Sabbagh, H.A.; Sabbagh, L.D.; Bowler, J.R. (Sabbagh Associates, Inc., Bloomington, IN (USA)). pp 479-486 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Recent progress toward developing a model of ferrite-core probes over composite workpieces is reviewed. The field computations differed from those with air-core probes in that the ferrite core involved the solution of amperian currents not known a priori. The solution for the magnetic field intensity was obtained from an integral equation involving the electric and magnetic Green tensors and the electric and magnetic amperian current sources. The discretization of this equation yielded a large-scale numerical problem with some special structures. The use of convolutions, correlations, and conjugate gradients in efficiently solving these electromagnetic problems is discussed.

1362 **Coil parameter influence on eddy current probe sensitivity.** Capobianco, T.E.; Vecchia, D.F. (National Bureau of Standards, Boulder, CO (USA)). pp 487-492 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The causes of variations in probe sensitivity related to probe coil construction parameters were investigated. The parameters include wire gauge, number of turns, coil winding cross section, ferrite permeability and diameter, and scatter winding compared to precise layup. A test method for predicting probe sensitivity was devised. The results were subjected to statistical analysis and a general statistical model incorporating these parameters was constructed.

1363 **Inductive arrays for near-field edge tracking and ranging.** Rosengreen, A.; Bahr, A.J.; Marsland, D.M. (SRI International, Menlo Park, CA (USA)). pp 493-500 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An array of near-field electromagnetic sensor elements based on printed-circuit single-turn loops was designed and tested for its applicability to edge tracking and ranging in NDE and robot control. The digital value of the sensor-loop voltage level, measured by a computing voltmeter, is fed to an HP1000 computer which also selects the channel to be measured, performs any required computations on the measured voltages, and controls the position of the X-Y stage using an algorithmic interpretation of these voltages. A block diagram of the acquisition system and sensor array is given and measured discriminator characteristics for different edge rotations are graphed. Edge tracking and ranging characteristics are also evaluated. A model is presented which depicts the scanning of a differential sensor pair across a small step in the conducting plane and uses the reciprocity method described by Auld.

1364 **Numerical modeling of capacitive array sensors using the finite element method.** Heyliger, P.R.; Moulder, J.C.; Shull, P.J.; Gimple, M.; Auld, B.A. (National Bureau of Standards, Boulder, CO (USA)). pp 501-508 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The numerical simulation of a capacitive array sensor and its performance relating to flaw detection in dielectric and metal plates is addressed. Solutions are presented for field equations for the geometry, material properties, and boundary conditions corresponding

to the effect of the presence of a flawed plate on the sensor. Probe response was calculated as the change in admittance which was computed using a line integral that is a function of the scalar potential and its normal derivative with respect to the specimen surface. The electrostatic potentials were calculated using a two-dimensional finite element method. Results of several parametric studies which show the relative effects of flaw size, specimen dielectric constant, and probe liftoff distance are presented.

1365 **Position and sample feature sensing with capacitive array probes.** Gimple, M.; Auld, B.A. (Stanford Univ., CA (USA)). pp 509-515 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The basic multiple capabilities of capacitive array probes was demonstrated previously by the authors. This paper develops the theory in detail and applies it in interpreting the experimental results. The array consists of tiny electrodes which serve as either source or receiver electrodes. In quantitative NDE and robotics a source of concern is whether the output signal response can be resolved independently into responses due to material properties and responses due to geometric factors. Theoretical results indicate that for capacitive arrays it is possible to determine very simple geometric factors (position) independent of sample dielectric constant (feature) and that the reverse also holds true.

1366 **Applications of capacitive array sensors to nondestructive evaluation.** Shull, P.J.; Moulder, J.C.; Heyliger, P.R.; Gimple, M.; Auld, B.A. (National Bureau of Standards, Boulder, CO (USA)). pp 517-523 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A capacitive array sensor was designed and fabricated for NDE applications and tested on both dielectrics and conductors. The response of the probe to steps and notches was characterized and the liftoff effect was studied. Buried flaws at depths greater than 4 mm were detected in dielectrics. In both insulators and conductors the probe was highly sensitive to surface features. Preliminary studies using the probe were also conducted in typical NDE applications including crack detection in glass, thickness and porosity monitoring in ceramics, and dielectric property determination during epoxy curing.

1367 **Overview of fiber-optic applications to smart structures.** Udd, E. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). pp 541-546 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Fiber optic technology is well suited to the realization of smart structures in that it offers lightweight high performance sensors that may be imbedded directly into the structure. The dielectric nature of these sensors offers the advantages of immunity from electromagnetic interference with the resulting shielding issues and the elimination of conductive paths. This paper provides a brief overview of the application of fiber optics to smart structures in aerospace structure and leak monitoring, pressure vessel control systems, and interferometry. System illustrations of these applications are included.

1368 **Prototype polarimetric based fiber optic strain gauge.** Brennan, B.W. (Simmonds Precision, Vergennes, VT (USA)). pp 547-552 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A fiber-optic strain monitoring system for the NDE of composite materials is described and some initial strain measurements in a uniaxial graphite/epoxy coupon are evaluated. The system is based on the effect of strain induced birefringence and the change in polarization state of a polarized optical signal from a laser passing through the test composite. Block diagrams of the instrumentation and the signal conditioner are included. Results are given for an optical fiber embedded into a 16 ply laminate made from Hercules AS4/3501-6 graphite prepeg.

1369 **Local strain measurements using optical fiber splices and time domain reflectometry.** Zimmerman, B.D.; Murphy, K.A.; Claus, R.O. (Virginia Polytechnic Institute, Blacksburg (USA)). pp 553-558 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method was developed for strain measurement based on optical time domain reflectometry which uses optical fiber splices that reflect pulses back at distinct points in time. These splices allow strain analysis on a local basis if distributed among crucial locations within a structure. Equations were derived for determining the power budget of the fiber splice. Experiments were conducted in which a single-splice fiber was loaded and the relative shifts of the Fresnel back reflected pulses from the end of the splice were monitored. The reflectometer system consisted of a pulsed laser, a beamsplitter, and a detector. Oscilloscope traces of the reflected pulses are included. Means for optimizing system resolution and flexibility are suggested.

1370 **Method for monitoring strain in large structures: optical and radio frequency devices.** Rogowski, R.; Holben, M. Jr.; Heyman, J.; Sullivan, P. (NASA Langley Research Center, Hampton, VA (USA)). pp 559-563 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A system was developed for measuring distance and displacement in large flexible structures using an amplitude modulated laser and an optical phase locked loop that maintains a constant phase relationship between a reference and detected signals. Strains of 10^{-7} were detected with the system using optical fiber and radio-frequency transmission lines. Applications for strain distribution measurements over very long gauge lengths and as embedded sensors in smart structures are discussed and results obtained with a radiofrequency transmission line attached to a stainless steel sample subjected to a tensile load are graphed.

1371 **Distributed fiber-optic sensor for passive and active stabilization of large structures.** Schoenwald, J.S.; Beckham, P.M. (Rockwell International Corp., Thousand Oaks, CA (USA)). pp 565-573 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A lightweight, noninvasive, continuous, distributed sensing system based on the use of a single optical fiber is described. The method relies on applying optical time domain reflectometry in a multimode optical fiber to observe the magnitude and location of structural distortions or other measurands. The fiber can be distributed throughout the structure to detect various components of flexure, including cantilever bending, torsion, longitudinal extension, and temperature. The spatial location and magnitude of the measurand is contained in the time domain return signal. The particular property measured is a function of the method in which the fiber is attached to the structure. Absolute displacements of 0.2 microns are measured reliably.

1372 **High speed heterodyne holographic interferometry.** Wagner, J.W. (Johns Hopkins Univ., Baltimore, MD (USA)). pp 575-584 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

High speed heterodyne holographic interferometry provides a means by which the attributes of both high speed photographic and single point probe measurement may be combined. This paper discusses the advantages and applications of this method in nondestructive evaluation procedures for composite and metal structures and explains the physics involved in the method. Comparisons are drawn to homodyne holographic interferometry. The ability of the new method to separate the variables of surface displacement, average image intensity, and fringe contrast in order to provide a direct measure of displacement from intensity information is discussed. Limitations on the method are evaluated.

1373 **Laser-based ultrasonics for the inspection of solids.** Addison, R.C. Jr.; Graham, L.J.; Linebarger, R.S.; Tittmann, B.R. (Rockwell International Science Center, Thousand Oaks, CA (USA)). pp 585-594 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method for using noncontact laser-based techniques for the generation and detection of ultrasound in solids is described. The generation technique uses a high power laser modulated at 1-10 MHz to thermoelastically generate a short tone burst of ultrasound in the solid. By arranging to have several laser spots impinge on the material, an array of ultrasonic sources can be generated, and the ultrasonic beam synthesized from the array can be focused and steered over a range of angles. The suitability of using laser-generated thermoelastic sources as array elements is assessed. The detection technique makes use of a Fabry-Perot interferometer to measure surface displacement caused by echoes reflected from flaws within the material. The sensitivity of the detector and the degradation that results when it is scanned over the surface are evaluated.

1374 **Evaluation of design parameter tolerances for producing ultrasonic transducers of reproducible performance characteristics.** Kwun, H.; Jolly, W.D.; Light, G.M.; Wheeler, E. (Southwest Research Institute, San Antonio, TX (USA)). pp 595-602 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Tolerance limits on the design parameters of transducers required to maintain their performance characteristics within certain specifications are analytically evaluated. A computer program for calculating transducer performance, including the center frequency, bandwidth, and insertion loss based on the transmission line model of Krimholtz, Leedom, and Matthaei was used to perform the parametric analysis. The design parameters included acoustic impedance, resonant frequency, capacitance, and the electromechanical coupling constant of the piezoelectric element. The effects of each parameter on transducer performance was determined using Hadamard matrix experimental designs.

1375 **Vibration characteristics of the front face of an ultrasonic transducer deduced from his acoustical radiation.** El Kihel, B.; de Belleval, J.F.; Gatignol, P. (Universite de Compiegne (France)). pp 603-608 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Acoustic field measuring techniques were developed which use hydrophones or small targets in echographic mode to determine the radiated field spatially for every position in time and frequency. Numerical methods were also devised to predict the acoustic field of a transducer in one medium or in two media separated by plane interfaces. These methods made it possible to compare the calculations against experimental data and to determine which velocity profile on the transducer face was related to the measured acoustical radiation.

1376 **Characterization of wideband ultrasonic transducers using pulse preshaping.** Benson, S.E.; Clark, G.A.; Lewis, D.K.; Cook, B.D. (Lawrence Livermore National Lab., CA (USA)). pp 609-615 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A high speed digital to analog converter was used to generate Gaussian pulses of various half-widths. These were amplified and used to excite wideband commercial ultrasonic transducers of different nominal frequencies. The ultrasonic beam was reflected off a flat smooth surface orthogonal to the beam and at a known distance. The experiment was done in pulse-echo mode and used the same transducer as a receiver. These reflected waveforms were analyzed and a model was proposed for wave generation and propagation. The spreading and symmetry predicted by the model were observed to occur.

1377 **Wideband transducer applicable on arbitrary surfaces of solids.** Halacinski, B.; Latuszek, A.; Jodko-Narkiewicz, J. (Warsaw Univ. of Technology (Poland)). pp 617-620 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A TAW-SAW piezoelectric transducer is described which operates by inducing perpendicular shear vibrations in a surface to which it is attached. These mechanical vibrations generate surface acoustic waves of the Rayleigh type in the sample being tested. The electrodes are located on the sides of the transducer to make mechanical damping possible and allow a wide conversion band to be obtained. The transducer can also work in the echo mode. Sample acoustic requirements for the proper application of the transducer and mathematical considerations supporting the transducer design are discussed.

1378 **Investigation of scatter in ultrasonic responses caused by variability in transducer and material properties.** Bennink, D.D.; Pate, A.L. (Iowa State Univ., Ames (USA)). pp 621-628 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Three approaches to reducing data scatter in ultrasonic defect evaluation have been developed within the NDE community: the specification approach, based on specifying the allowable characteristics of all system components; the standard approach, based on calibrating the measurement by comparing it with a set of standard defects; and the modeling approach, based on making corrections to the response for all major variables that are not flaw dependent. This paper compares the standard and modeling approaches and examines the ability of each for data scatter reduction. A measurement model developed by Thompson and Gray was used as the basis for the modeling approach. Two groups of transducers were investigated: a group having identical nominal characteristics and a group whose characteristics varied.

1379 **Transient acoustic radiation fields in solids from wide sources.** Bresse, L.F.; Hutchins, D.A. (Queen's Univ., Kingston, Ontario (Canada)). pp 629-636 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method for computing the transient radiation from a wide circular source acting at a solid surface is given for ultrasonic generation by both a transducer and a pulsed laser. The method allows an exact formulation of the impulse response to be obtained for the two components of the displacement at any point located inside the solid. Experimental results for aluminum are compared with theory and the concept of plane and edge waves is discussed.

1380 **Mapping of ultrasonic fields in solids.** Good, M.S.; Van Fleet, L.G. (Pacific Northwest Lab., Richland, WA (USA)). pp 637-646 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC06-76RL01830.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An experimental system was developed to investigate the distortion of an ultrasonic field propagating through coarse-microstructured materials. The system permits mapping of the field by means of longitudinal and/or shear wave microprobes. This paper discusses the field mapping system, data acquisition and analysis pertaining to reactor grade centrifugally cast stainless steel (CCSS), and system application to assess the effect of surface conditions on an ultrasonic inspection. Two CCSS material microstructures - equiaxed and columnar - were used to acquire field maps.

1381 **New look at ultrasonic focusing devices.** Turner, J.L. (Welding Institute, Cambridge (England)). pp 647-662 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Experimental and theoretical design and performance data are given for a range of axicon, toroidal, and spherical lenses attached to proprietary transducers. The major beam parameters were related to a focusing factor defined as the nearfield length divided by the focal length. Wave interactions and beam parameters such as the focal spot diameter, divergence angle, sidelobe amplitudes, inspection range, and focal point pressure are analyzed and graphed for the three lens types. Transducer focusing results are evaluated and beam plots are given for comparative purposes.

1382 **High frequency, high power ultrasonic transducers.** Patel, N.D.; van den Andel, J.; Nicholson, P.S. (McMaster Univ., Hamilton, Ontario (Canada)). pp 663-670 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

New piezoelectric ceramics with low dielectric constants and high thickness coupling coefficients were developed for use in compressional wave ultrasonic transducers. These elements had low radial mode coupling and a moderate quality factor. Both planar and focused transducers were fabricated and excited with both impulse and tone-burst systems. Output signals were compared with those of available commercial transducers and showed a 15-20 dB increase. The piezoelectric properties of polyvinyl difluoride, lithium niobate, sodium potassium niobate, and three lead metaniobates were determined. Carpet diagrams and density profiles are given.

1383 **Quantitative modeling and experimental analysis of the physical properties of electromagnetic-ultrasonic transducers.** Wilbrand, A. (Fraunhofer-Institute for Nondestructive Testing Univ., Saarbruecken (West Germany)). pp 671-680 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A physical transducer model was developed using the theory of electromagnetic-ultrasonic transduction in ferromagnetic metals. The results were analyzed to derive the essential rules for transducer behavior and were systematically checked in a series of experiments. The theoretical results are briefly outlined and the analysis and experimental verification is demonstrated for a practical transducer configuration.

1384 **Pressure measurement using microballoons.** Lhota, J.R.; Panos, G.C.; Hawkins, G.F.; Schurr, J.N. (Aerospace Corp., El Segundo, CA (USA)). pp 691-695 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The use of hollow glass microspheres as imbedded sensors to record the maximum pressure attained in a fluid was tested. The technique was developed in response to test requirements of the Titan Recovery Program following the April 1986 failure of a Titan solid rocket motor. Its purpose was to measure the maximum pressure exerted by the trapped O-ring grease in the joint between the motor casing segments. Access and size considerations prohibited the use of standard transducers. The grease was tagged with a microsphere material that changed irreversibly with pressure. Glass microspheres were chosen because they break over a range of pressures and emit noise in the process. Post test samples of the tagged grease were analyzed by acoustic emission and scanning electron microscopy.

1385 **Study of the mechanical properties of crystals for surface acoustic wave force sensors.** Rokhlin, S.I.; Rokhlin, M.I.; Kornblit, L.; Gorodetsky, G. (Ohio State Univ., Columbus (USA)). pp 697-704 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results are summarized for an investigation into the static and fatigue strength parameters of quartz and silicon crystals used in surface acoustic wave sensors. Testing and instrumentation systems used in the experiment are described and illustrated. Strength depended significantly on surface finish. Results for fracture toughness for variously cut crystal faces are listed. The dynamic range and resolution of the sensors and the role of strain in these properties were assessed. Wave velocities were also measured.

1386 **Video data enhancement for nondestructive evaluation.** Merenyi, R.; Heller, W.G. (Analytic Sciences Corp., Reading, MA (USA)). pp 705-712 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Real time NDE image processing and enhancement approaches are discussed. Applicable computer hardware is detailed and the software requirements and constraints for implementing a working system are overviewed. The implementation and use of a video enhancement system to monitor the Three Mile Island reactor cleanup process is described. Applications of real time image processing in the tangential radiography of large objects, integrated circuit microscopy, and the inspection of bridges are briefly assessed.

1387 **Digital image acquisition for x-ray image processing.** Russell, S.F. (Iowa State Univ., Ames (USA)). pp 713-721 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The technical issues involved in obtaining the best possible digital images from radiographs are discussed. The design and performance of a digital acquisition and analysis system for radiographs is described and sources of measurement error, distortion, and noise are evaluated. Measurements of the optical density of an x-ray film step tablet were taken with a vidicon TV camera and associated optics to illustrate linearity, dynamic range, and intensity granularity effects. Results are graphed in detail. Resolution optimization possibilities are analyzed.

1388 **Use of a priori information in incomplete data x-ray CT imaging.** Eberhard, J.W.; Hedengren, K.H. (General Electric Corporate Research and Development, Schenectady, NY (USA)). pp 723-730 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A new technique for utilizing a priori information is presented which uses CAD electronic part models to make use of effectively all the information which is available in the blueprint of a selected industrial part. Significant improvements in x-ray image quality are demonstrated using the technique in the image enhancement of the model of an exhaust nozzle actuation ring for the F110 aircraft. Three approaches were evaluated: a projection data approach, an iterative reconstruction approach, and an image processing and analysis approach. Results for these approaches are included. X-ray CT images of the simulated part image reconstructed with several choices of available angular range are shown.

1389 **Survey of image compression techniques.** Lovewell, B.K.; Basart, J.P. (Iowa State Univ., Ames (USA)). pp 731-738 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimento, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Following a general discussion of the image compression process five techniques are surveyed that are used for the compression of digitized industrial radiographs used in material evaluation. The techniques include differential pulse code modulation, vector quantization, hybrid coding, transform coding, and block truncation coding. Specific implications of these techniques for quantitative NDE are addressed.

1390 **Evaluation of thresholding heuristics useful for automated filmless radiography.** Bell, Z.W. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). pp 739-746 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC05-84OR21400.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Four gray-level thresholding techniques were applied to a simulated digital radiograph constructed to test the sensitivity and robustness of the techniques under various conditions of background and signal-to-noise ratio. The effects of using local and global background estimates in conjunction with conventional and probabilistic (soft) thresholding were investigated. Soft thresholding was more suited to radiographic image segmentation than conventional thresholding because of the dominance of a single mode in the gray-level histogram. Blurring effects were also compared.

1391 **Improved axial resolution of ultrasonic B-scans by L1-norm deconvolution.** McRae, K.I.; Zala, C.A. (Defense Research Establishment Pacific, Victoria, British Columbia (Canada)). pp 747-755 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A new time domain algorithm recently applied to the analogous geophysical imaging problem is wavelet deconvolution via a spike train extraction procedure which minimizes the L1-norm of a residual error term. The main application of this deconvolution technique to the improvement of ultrasonic B-scans has been the imaging of adhesively bonded interfaces such as the titanium to graphite-epoxy steplap joint. Modeling of the pulse-echo wave form detected by the transducer is first described. Then a fast L1-norm algorithm for deconvolving the impulse response from a measured ultrasonic trace is presented. The algorithm is then evaluated in the deconvolution of synthetic ultrasonic A-scans and B-scans. Image results are illustrated.

1392 **Nonlinear spectral processing techniques for ultrasonic imaging.** Bilgutay, N.M.; Bencharit, U.; Saniie, J. (Drexel Univ., Philadelphia, PA (USA)). pp 757-767 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A spectral processing technique was used in conjunction with several noise suppression algorithms for image enhancement. Large grained stainless steel samples with flat-bottom holes were used to evaluate the performance of each algorithm. The nonlinear signal processing algorithms were implemented for 2-D imaging. Two algorithms, namely minimization and polarity thresholding, provided a significant reduction in the grain echos while maintaining a strong flaw signal. For optimal parameters the polarity thresholding algorithm achieved the best improvement while the minimization algorithm performed better than mean standard deviation and linear averaging.

1393 **Frequency stepping for aperture synthesis and axial resolution in acoustic holography.** Bossi, R.H.; Hildebrand, B.P. (Boeing Aerospace Co., Seattle, WA (USA)). pp 769-776 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The use of frequency stepping and the advantages it affords for acoustic holography are described in a series of reconstruction examples using spherical targets in water, steel spheres in air, a hole drilled in an aluminum block, and a sawcut. Improvements in axial resolution using frequency stepping and inverse Fourier transforming to obtain B-scan images are discussed. 3-D images were obtained which accurately placed the ultrasonic echos in the spatial volume of the scan. Frequency stepping was also used to synthesize an aperture which resulted in artificial holograms of the targets.

1394 **Application of pattern recognition techniques to B-scan analysis.** Martin, R.W. (Univ. of Dayton Research Institute, OH (USA)). pp 777-784 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Several pattern recognition techniques were used to identify defects in ultrasonic backscatter B-scans of composite materials. A threshold was applied to a rectified B-scan to produce a binary image. Then each unconnected component of the binary image was assigned a unique label. Various statistics such as area, integrated optical density. Perimeter, axis angle, and x, z location were then computed for each unlabeled component. If-Then rules were applied in an expert system mode to these statistics to identify each component as front surface or back surface, delamination, front or back surface connected crack, noise, or an unidentified feature. The technique successfully identified both surface cracks and delaminations in graphite/epoxy laminates.

1395 **Trend removal in x-ray images.** Doering, E.R.; Basart, J.P. (Iowa State Univ., Ames (USA)). pp 785-794 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Techniques are presented for removing the geometrical background intensity trends along with a method for detecting a specific class of x-ray flaws. The trend removal techniques are discussed as a pre-processing stage followed by a pixel classification technique. Both methods are based on polynomial regression. The subsequent application of a signature identification technique for void-like flaw detection is then described. Results derived from the imaging of porosity or void-like defects in the case of a railroad rail weld are evaluated.

1396 **Image analysis, feature extraction, and various applied enhancement methods for NDE x-ray images.** Zheng, Y.; Basart, J.P. (Iowa State Univ., Ames (USA)). pp 795-804 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A general procedure is presented for enhancing a low-contrast radiographic x-ray image and evaluating flaws in the image. The procedure includes image analysis, image enhancement, and image feature extraction. Enhancement methods tested include trend removal, dynamic range expansion, histogram equalization, and median, sigma, adaptive smoothing, and Kalman filtering. The feature extraction methods used include flaw spatial activity detection by the masking function and flaw detection by image segmentation. A digitized x-ray image of a weld is discussed to demonstrate the performance of the procedure.

1397 **Flaw-to-grain enhancement via the Wigner transform.** Hubbert, J.; Udpa, S.S. (Colorado State Univ., Fort Collins (USA)). pp 805-812 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method was developed for enhancing the signal-to-clutter ratio in ultrasonic testing through the use of the Wigner transform. The Wigner distribution is a two-dimensional function showing the distribution of energy as a function of time and frequency. It can be interpreted as giving bandpass filtered versions of the signal energy at each discrete point in time. These time-energy sequences may be combined using split-spectrum processing methods to increase the flaw-to-grain echo ratio. A specimen of centrifugally cast stainless steel pipe used in power reactors was inspected using the pulse-echo method. The received signal was split into a number of decorrelated time signals which resulted directly from the Wigner transform. These signals were then averaged to yield the enhanced signal. Preliminary results are graphed and evaluated.

1398 **NDE x-ray image modeling and adaptive filtering considering correlated noise.** Zheng, Y.; Basart, J.P. (Iowa State Univ., Ames (USA)). pp 813-820 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An adaptive Kalman filtering technique was developed to remove noise fluctuation caused by film-grain noise, film dirt, and quantum fluctuation in industrial-radiographic x-ray imaging. The knowledge of the x-ray image forming mechanism was used to obtain an autoregressive model of the image. The autoregressive representation was written in state-space form and incorporated into a Kalman filter by optimally separating a noise-free image process from a noise process. The technique was compared to other adaptive filtering schemes for image estimation. The recursive property of the Kalman filter enabled fast execution speeds when implemented on a VAX 11/780 computer. Digitized x-ray images of a weld are illustrated.

1399 **Multifrequency eddy current testing of steam generator tubes using optimal affine transformation.** Stolte, J.; Udpa, L.; Lord, W. (Colorado State Univ., Fort Collins (USA)). pp 821-830 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An alternative technique was developed for the implementation of multifrequency/multiparameter concepts for extracting defect signal information from complex measured eddy current data. The approach uses affine transformations which appropriately shape and rotate the basic frequency response similar to procedures used in image registration. Vector subtraction of the auxiliary frequency signals is then performed to obtain the relevant eddy current defect signal. The mathematics of the technique are discussed. The experimental setup for reactor steam generator tube imaging is described and results are graphed.

1400 **Signal processing for remote field eddy current inspection technique.** Udpa, S.S.; Ou-Yang, T.H.; Lord, W. (Colorado State Univ., Fort Collins (USA)). pp 831-838 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A practical approach was developed for defect classification using the remote field eddy current (RFEC) effect. The method uses a simulated differential probe to obtain a complex plane representation. The signals are classified using the Fourier descriptor method. The approach was tested for a variety of defects machined into a tube which included through-wall holes, axisymmetric outside diameter slots, and wall thinning. Signals taken in the presence of a steel flange around the tube were also evaluated. RFEC trajectories and their filtered versions are graphed and feature vectors are classified.

1401 **Techniques for reduction and analysis of large UT data sets.** Pickens, K.S.; Shoemaker, J.A.; Hamlin, D.R.; Peterson, R.H.; Grothues, H.L. (Southwest Research Institute, San Antonio, TX (USA)). pp 839-846 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A set of tightly integrated tools for the analysis of large multi-channel ultrasonic testing data sets was developed as part of the Southwest Research Institute enhanced data acquisition system (EDAS). The tools take advantage of recent advances in computer technology and user interfaces to provide a fast and easy to use image-based system. The interfaces are window and mouse based. The tools enable the EDAS to access gigabyte-sized ultrasonic data in seconds and display the reduced data in three modes: three-view, B-scan, and real time. These components and their operation are described in detail.

1402 **Two-dimensional regression filtering for edge detection.** Wong, C.Y.; Russell, S.F. (Iowa State Univ., Ames (USA)). pp 847-855 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A new local edge detection scheme called regression filtering was developed with the capacity to adapt to different noise environments. The technique affords adaptive window adjustment and selection of parameters for detecting local edges. First developed and tested on one-dimensional images, the technique incorporates the gradient estimation, edge height estimation, location of an edge, and an edge definition table to obtain final edge intensity representations, and has been applied to two-dimensional imaging by processing row-by-row and column-by-column. To illustrate the tech-

nique a simulated noiseless one-dimensional signal corrupted by Gaussian noise was used. An extension of the method that uses an nx3 sliding window method along with test results for this method on several radiograph images are described.

1403 **Evaluation of the effects of prior flaw information on Wiener filter based ultrasonic flaw scattering amplitude estimation.** Neal, S.P.; Thompson, D.O. (Iowa State Univ., Ames (USA)). pp 857-864 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results are evaluated for the robustness of a Wiener filter in the face of broad flaw distributions and in the face of errors in characterizing this distribution. Both narrow and broad ensembles of lognormally distributed flaw sizes were considered. Scattering amplitude estimation errors arising from errors in estimating flaw distribution mean and variance were evaluated. The tendency of prior flaw information to bias the filter in such a way that it may lead to oversizing of small flaws and undersizing of large flaws was also investigated. Filtering capacity was compared to a desensitization filter. For broad flaw distribution the filter showed little biasing tendency.

1404 **Split spectrum processing: performance of the polarity thresholding algorithm in signal-to-noise ratio enhancement in ultrasonic applications.** Newhouse, V.L.; Rose, J.L.; Karpur, P.; Shankar, P.M. (Drexel Univ., Philadelphia, PA (USA)). pp 865-874 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The performance of a nonlinear polarity thresholding algorithm was evaluated for coherent noise suppression in ultrasonic signals when the signal-to-noise ratio of the input signal was greater than unity. Probability of false alarm, probability of detection, and the receiver operating characteristics of the algorithm were developed so that its applicability to a given situation can be assessed before utilizing the technique. The algorithm introduces spurious high frequency contents to the grain noise amplitude and thereby motivates a low frequency bandpass filtering of the output signal to further reduce the coherent noise content of the signal. The results indicate that it is not necessary for the target signal amplitude to be larger than the noise level for an effective implementation of split spectrum processing.

1405 **Quantitative separation of overlapping echoes using the analytic signal magnitude.** Sippel, T.M.; Moses, D.J.; Gammell, P.M. (Marquette Univ., Milwaukee, WI (USA)). pp 875-880 of Review of progress in quantitative nondestructive evaluation. Volume 7A. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Quantitative relations were investigated between the peaks of the analytic signal magnitude in ultrasonic testing and the separation in arrival time of the component signals. These relations were studied by synthesizing multiple-mode waveforms by adding two single-mode waveforms with a known separation in time. A single-mode waveform was digitized with the shear wave polarization along the rolling direction. Composite waveforms were then formed by adding this waveform to a shifted version of itself. The analytic signal magnitude was derived by Fourier transforming the waveform, setting the negative frequency components to zero, and then calculating the envelope as the magnitude of the complex signal. The analytic signal provided the true envelope and rate-of-arrival of the composite waveform energy.

1406 **Interfaces: the next NDE challenge.** Wadley, H.N.G. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 881-892 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Problems and prospects in the nondestructive measurement of material interfaces along which fracture and stress corrosion paths occur are reviewed. Grain boundary phenomena are related to brittle-ductile and impact behavior and temperature for low alloy steels. Mechanical property dependence on grain structure and on segregation is discussed for a variety of intermetallic alloys seen as candidate gas turbine engine materials. Fracture behavior for several ceramics is described relative to stress and microstructural phenomena. Correlations between interfacial defects, lattice constants, and opto-electronic properties in GaAs films on Si substrates are assessed. Composite interfaces and their measurement needs are also evaluated.

1407 **Application of SH and Lamb wave EMAT's for evaluation of adhesive joint in thin plate.** He, F.; Rokhlin, S.I.; Adler, L. (Ohio State Univ., Columbus (USA)). pp 911-918 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The applicability of shear waves for evaluating adhesion was tested using thin carbon steel plates glued together with a commercial adhesive. The experiment focused on the relations between the acoustic parameters and geometry conditions, the comparison of ultrasonic data and strength data for the joint, and the wave attenuation under given variables. Both lap-shear samples and long samples were tested. Non-contact electromagnetic acoustic transducers were used for the excitation and reception of shear waves. The use of Lamb waves was also investigated for the same sample parameters.

1408 **Influence of material dissipation and imperfect bonding on acoustic wave reflection from layered solids.** Mal, A.K.; Yin, C.C.; Bar-Cohen, Y. (Univ. of California, CA (USA)). pp 927-934 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

It was demonstrated that the inclusion of material dissipation in layered materials has a dramatic influence on the spectrum of the reflection coefficient of acoustic waves especially when the solids are overlaid by fluids. A theoretical technique was developed for the rapid and accurate calculation of the spectrum for general types of layers. The calculations correlated well with data from both immersion and bubbler type leaky Lamb wave experimental arrangements. The model was designed to relate the reflection coefficient amplitudes to the material properties of the solids and to determine those coefficients as functions of incidence angle and frequency. The nature and location of holes in the spectrum are also discussed.

1409 **Determination of delaminations in adhesively bonded layers under compression.** Batra, N.K.; Chaskelis, H.H. (Naval Research Lab., Washington, DC (USA)). pp 943-951 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

To determine the presence of delaminations in adhesively bonded layers by ultrasonic methods, the changes which occur in the propagating ultrasonic energy must be uniquely attributable to the delamination effects. Determination of absolute attenuation and its variation in each adherend layer is prerequisite. In addition, the

distinction between adhesively bonded interfaces from those just in physical contact must be established. We describe a systematic study of the effect of compression on bonded and unbonded areas on ultrasonic attenuation. The results of the simulation experiment are used to interpret digital images of adhesively bonded polyethylene-rubber-steel piston inserts.

1410 **Elastic wave dispersion in laminated composite plate.** Datta, S.K.; Shah, A.H.; Al-Nassar, Y.; Bratton, R.L. (Univ. of Colorado, Boulder (USA)). pp 987-994 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Dispersion curves are presented for the propagation of in-plane and out-of-plane waves propagating along the fibers in a fiber-reinforced plate. The curves differed significantly from those in an isotropic plate. Dispersion curves for waves propagating in a cross-ply laminate with interface layers also demonstrated major differences from those for a laminate without interface layers. Both these curves were different from those for single-layered reinforced plates. The most important features of the curves for a plate with interface layers were the lowering of the cut-off frequencies and their slopes. This was seen to have a major effect on the overall plate response and to allow for the ultrasonic characterization of interface properties.

1411 **Quantitative nondestructive evaluation technique for assessing the compression-after-impact strength of composite plates.** Gosse, J.H.; Hause, L.R. (Boeing Aerospace Co., Seattle, WA (USA)). pp 1011-1020 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A preliminary method is described for assessing impact damage and residual compressive strength in impacted laminar composites and is tested on two systems consisting of a 934/T-300 prepeg and an 8551/IM7 composite. The method consists of ultrasonic pulse-echo scanning utilizing time-of-flight information to determine first-echo delamination spatial and depth geometry. The delamination depth maps are recorded digitally and later photographed. An analytical model integrated with maps is used to reconstruct the impact damage state. The usefulness of this reconstructed state is illustrated by identifying critical Euler instabilities within the damage region as a function of the post-damage loading condition. Classical laminate analysis is then used to determine the residual compressive strength.

1412 **Eddy current probe impedances due to interaction with advanced composites.** Bowler, J.R.; Sabbagh, H.A.; Sabbagh, L.D. (Sabbagh Associates, Inc., Bloomington, IN (USA)). pp 1021-1027 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Probe interaction impedances were calculated for cylindrical air-cored coils under the assumptions that the coil axes are 1) normal and 2) tangential to the surface of a homogeneous uniaxial conductor. The impedances were found from closed form expressions for both the normal and tangential coils. Field calculations are given. Rather than calculating the field in a multilayered structure a uniaxial half-space was considered and the TE and TM potentials for arbitrary current source were determined using Green's functions. Coil impedance variations with frequency are graphed.

1413 **Thermographic detection of buried debonds.** Quinn, M.T.; Hribar, J.R.; Ruiz, R.L.; Hawkins, G.F. (Aerospace Corp., Los Angeles, CA (USA)). pp 1117-1123 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The sensitivity of thermographic imaging techniques in detecting deeply buried debonds was evaluated for the purpose of using the techniques as NDE tools for increasing the reliability of solid rocket motors. The adhesive debonds tested occurred underneath 3/8 inch of steel and 1/4 inch of rubber insulation. Three test specimens were fabricated from 4340 steel. The steel was bonded to silica-filled nitrile butyl rubber which in turn was bonded to three inches of simulated propellant. Three debond sizes were tested. An infrared camera was used. Two heating techniques were used consisting of a water wand and a water bed. Uneven heating was the largest error source but was accounted for by careful data analysis. Finite element modeling adequately simulated the experiments and demonstrated that debonds could be detected at depth under a wide range of materials.

1414 **Sub-bandgap laser probing of GaAs devices and circuits.** Mechtel, D.M.; Andreou, A.G.; Christodoulides, D.N.; Wagner, J.; Westgate, C.R.; Palmer, C.H.; Poehler, T.O. (Johns Hopkins Univ., Baltimore, MD (USA)). pp 1133-1140 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

This review discusses the limitations of standard test methods at GHz speeds, describes the basic principles of electro-optic laser probing, and explores some applications for the process. The method is based on the linear electro-optic effect measured as the change in the index of refraction of a crystal in the presence of an electric field. GaAs is a cubic crystal and its refractive index ellipsoid is a sphere. A field-induced change in its index deforms the index ellipsoid from its spherical shape. The measurement of this deformation constitutes the basis of electro-optic probing. Geometries are presented for both front and back side probing. The mathematics of the method are given along with instrumentation configurations for continuous wave and pulsed probing.

1415 **Semiconductor dimensional metrology using the scanning electron microscope.** Utterback, S.G. (IBM T.J. Watson Research Center, Yorktown Heights, NY (USA)). pp 1141-1151 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The use of scanning electron microscopy for surface structure and composition diagnostics in semiconductors is analyzed from both an optical and solid state perspective. Problems related to electron beam interaction with semiconductor surfaces from the standpoints of electron scattering and surface damage are examined. Equipment complexities and requirements are assessed. Critical dimension and pitch measurements using the technique are discussed along with measurements for linewidth and sidewall slope. Electron range calculations pertinent to microscope and semiconductor considerations are presented.

1416 **Spatially resolved non-contact bulk and surface photovoltage response in semiconductors.** Guidotti, D. (IBM, T.J. Watson Research Center, Yorktown Heights, NY (USA)). pp 1167-1176 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The principles of non-contact ac photovoltage measurements and the use of the photovoltaic effect in nondestructive evaluation are assessed. Applications in the nondestructive inspection of VLSI wafers during processing and for early electrical testing prior to chip packaging are evaluated. Scanning ac surface and bulk photovoltage methods are described. Using solid state and optical premises. Areas where the measuring methods can be used at low pho-

toexcitation levels to probe fundamental processes such as trapping energy and carrier lifetime and kinetics are discussed.

1417 **High resolution holographic contouring.** Wagner, J.W. (Johns Hopkins Univ., Baltimore, MD (USA)). pp 1177-1184 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Holographic contouring coupled with heterodyne analysis methods were used to provide high resolution contour mapping of specular and diffuse object surfaces. These combined methods permitted automated analysis of surface contours while maintaining the raw data in an archival form on a hologram. A new technique called coherence multiplexing was shown to permit single exposure dual reference holographic recordings. Multiplexing facilitated high speed recording so that the dynamics of rapid contour changes could be studied with the sensitivity of heterodyne analysis. Contour sensitivities approaching Angstroms were possible using direct interferometric contouring of specular surfaces.

1418 **Microstructure characterization with a pulsed laser ultrasonic source.** Telschow, K. (EG & G Idaho, Inc., Idaho Falls (USA)). pp 1211-1218 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC07-76ID01570.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Localized heating produced by absorption from a pulsed laser provides an efficient noncontacting source of ultrasonic waves in materials. Experimental results are presented to illustrate the feasibility of this type of source for the characterization of microstructure in metal and ceramic materials. Piezoelectric and capacitive wide bandwidth detection transducers were used to record attenuation and scattering in these materials for comparison with the conventional pulse echo technique. Laser sources were determined to be efficient and versatile sources. Stainless steel and Inconel samples were used.

1419 **Elastic constant determination using generation by pulsed laser.** Bresse, L.F.; Hutchins, D.A.; Lundgren, K. (Queens Univ., Kingston, Ontario (Canada)). pp 1219-1226 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A technique for the accurate estimation of elastic constants in solid materials is described. Experimental waveforms generated in a plate by a Q-switched pulsed ruby laser were compared with theoretical solutions for a point source. Nonlinear least square fit was used to obtain the longitudinal and shear velocities of the material. The waveforms were detected with an interferometer for their on- or off-epicenter properties. Aluminum served as the plate material and was tested under both oil evaporation and thermal expansion conditions. The choice of the optimal receiver position was determined.

1420 **Scattering induced attenuation of ultrasonic backscattering.** Nagy, P.B.; Adler, L. (Ohio State Univ., Columbus (USA)). pp 1263-1271 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Different techniques for measuring ultrasonic attenuation in inhomogeneous media were experimentally compared and the scattering induced attenuation was shown to be highly dependent on the measuring method. Coherent transmission measurement yielded the highest possible scattering induced attenuation while backscattering techniques in the diffuse region gave zero scattering induced attenuation. The actual value was always somewhere between these limiting values. It was theoretically shown that the general assumption that the backscattering is attenuated in the same way as the coherent wave is not true and that the backscattered signal is considerably less attenuated than the coherent transmission. Experimental results on different types of grain and roughness inhomogeneities in aluminum, copper, and carbon steel verified this conclusion.

1421 **Effects of imperfect interfaces on acoustic transmission and diffraction.** Rehbein, D.K.; Van Wyk, L.; Thompson, R.B.; Buck, O. (Iowa State Univ., Ames (USA)). pp 1301-1310 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A study was conducted into variations in the degree of contact between fatigue crack faces caused by changes in the effective stress intensity range generated during crack growth and the resulting changes in the transmitted and diffracted waves. The stress changes used included an overload block, a single cycle overload, and a continually decreasing applied stress intensity range. The applied stress intensity range was modified to include the effects of crack tip shielding. The functional form required by the spring constant in the distributed spring model necessary for matching the model results to experimental data was derived. The angular dependence of the tip diffracted and mode converted signal is described experimentally and from model predictions. The fatigue cracks were grown in compact tension specimens of Al 2024-T351.

1422 **Acoustoelastic responses of an elastoplastically deformed body.** Wu, T.; Pao, Y. (Cornell Univ., Ithaca, NY (USA)). pp 1343-1348 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Uniaxial tests in the plastic range were conducted to evaluate the plastic strain effect on the change in acoustobirefringence, defined as the difference of two shear wave speeds polarized along two perpendicular directions, in carbon steel specimens. The theory proposed by Pao and Gamer was adopted. The theory is independent of any yield conditions of plasticity and holds that the effects of texture changes caused by plastic strain are characterized by two texture constants in acoustoelastic theory for an initially isotropic body. These texture constants were determined for the carbon steels using the uniaxial test results. A constitutive relation for the incremental second Piola-Kirchhoff stress and infinitesimal strain was postulated to incorporate the texture effect into the acoustoelastic theory.

1423 **Acoustoelasticity using surface waves in slightly anisotropic materials.** Mase, G.T.; Delsanto, P.P. (Univ. of Wyoming, Laramie (USA)). pp 1349-1356 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Numerical comparisons were drawn between the perturbation method of Delsanto and Clark and the exact numerical solution of Mase and Johnson as a function of anisotropy and applied stress as ways of determining the acoustoelastic response. Basic equations of surface waves are reviewed. Equations from the perturbative approach and the six dimensional approach of Mase and Johnson are discussed. Surface wave speeds were calculated using the six dimensional approach for arbitrarily severe anisotropy. Changes in wave speed as a function of second- and third-order elastic constants and applied stress was studied to determine the linear range.

1424 **Acoustoelastic wave velocity in metal matrix composite under thermal loading.** Yen, C.; Chatterjee, S.N. (Materials Sciences Corp., Spring House, PA (USA)). pp 1357-1364 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Axial and transverse velocities in a unidirectional graphite-aluminum composite were analyzed using a composite model of acoustoelasticity which was extended from a simplified model of S. N. Chatterjee. Parametric studies were performed to determine the sensitivity of the constituent properties to the composite acoustoelastic response under thermal cycling. The properties included the Young and shear moduli, Poisson ratio, thermal expansion coefficient, mass density, and yield strength of the P55 fiber and the 6061 matrix. Results are graphed.

1425 **Ultrasonic methods of texture monitoring for characterization of formability of rolled aluminum sheet.** Clark, A.V.; Blessing, G.V.; Thompson, R.B.; Smith, J.F. (National Bureau of Standards, Boulder (USA)). pp 1365-1373 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The use of various ultrasonic techniques for texture monitoring in rolled aluminum alloy sheets was evaluated. The orientation distribution coefficients were measured on sheets obtained from actual production runs of a commercial alloy used for can stock. Measurements were made with different transducers and velocity measurement systems at different laboratories. The measurements were compared as an internal consistency check on the ultrasonic theories. An independent check was run by obtaining orientation distribution coefficients from neutron diffraction pole figures. Correlations of these coefficients with formability measurements were also investigated. Acoustic birefringence and arrival time difference measurements of lowest order symmetrical Lamb modes were used.

1426 **Energy distribution for SH-waves in slightly anisotropic materials.** Mignogna, R.B.; Delsanto, P.P.; Clark, A.V. (Naval Research Lab., Washington, DC (USA)). pp 1375-1382 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Experimental results are presented from measurements in rolled plate materials of normal incidence SH-waves as a function of polarization angle. The possible effects of slight anisotropy and a layered or inhomogeneous texture through the thickness are discussed. Inverse amplitude logs as functions of angle for the pulse-echo technique are graphed along with echo amplitudes as functions of echo number for 2024-T351 aluminum using the pitch-catch technique and for 7075-T651 aluminum using the pitch-catch and pitch-echo techniques.

1427 **Averaging techniques and ultrasonic pole figures.** Smith, J.F.; Li, Y.; Thompson, R.B. (Iowa State Univ., Ames (USA)). pp 1383-1390 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The usual approach to texture evaluation has been to describe a crystallite orientation distribution function (CODF) by a mathematical series and to use the ultrasonic measurements to evaluate the expansion coefficients in the series. This CODF can then be projected onto any desired plane to generate a pole figure. This paper addresses the averaging procedure which is part of this process. Comparisons of Voigt, Reuss, and Hill average values for the CODF expansion coefficients as evaluated from Lamb wave, ultrasonic, and x-ray and neutron diffraction data for four aluminum and copper samples are tabulated. X-ray and ultrasonic pole figures are comparatively graphed for rolled copper.

1428 **Complete evaluation of residual stress states using acoustoelasticity.** Johnson, G.C.; Dike, J.J. (Univ. of California, Berkeley (USA)). pp 1391-1398 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A method is presented for manipulating ultrasonic data from a complete longitudinal wave scan of a body subject to a plane state of residual stress in such a way that the complete state of stress can be evaluated at each scan point. The basic theory is presented and discussed and a numerical implementation of the pertinent equations is demonstrated for an ideal stress state similar to that found in a quenched iron rod. The assumed input is corrupted by noise to examine the robustness of the algorithm in the presence of such noise. Prospects are discussed for applying the technique to evaluate actual residual stresses in light of several potential difficulties.

1429 **Sensitivity of an ultrasonic technique for axial stress determination.** Cunningham, B.; Holt, A.C.; Johnson, G.C. (JAG Industries, Trinidad, CA (USA)). pp 1405-1412 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results are assessed for a series of experiments designed to investigate the capabilities and limitations of an automated ultrasonic method for axial bolt-stress determination. The method permits rapid determination of axial stress using pulse-echo time-of-flight measurements. Through the utilization of both shear and longitudinal waves the necessity of knowing the bolt's initial length or of having access to more than one end of the bolt can be avoided. A brief overview of the system theory and instrumentation is presented followed by a discussion of the effects of temperature, bond thickness, and plastic deformation on axial stress measurements made using the system.

1430 **Application of the nonlinear harmonics method to continuous measurement of stress in railroad rail.** Burkhardt, G.L.; Kwun, H. (Southwest Research Institute, San Antonio, TX (USA)). pp 1413-1420 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The nonlinear harmonics method was investigated as an approach for measuring thermally induced compressive stress in railroad rail. Laboratory measurements were taken while the probe was scanned along the web of a section of rail under compressive stress in a loading machine and exposed to a magnetic field. Approaches for reducing the effect of variations in material properties by using stress induced anisotropy and spatial averaging of the data were also investigated and were shown to be promising. A schematic diagram of the acquisition system is given and nonlinear harmonic signal amplitudes are graphed.

1431 **X-ray diffraction stress analysis as an NDE technique.** Pardue, E.B.S.; McSwain, R.H. (Technology for Energy Corp., Knoxville, TN (USA)). pp 1421-1428 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Nickel-plated 4340 steel samples were analyzed and evaluated in an attempt to compare fatigue life to residual stress levels. The testing program consisted of stress analysis followed by fatigue testing. Post-fatigue test stress analysis using x-ray diffraction was then performed and failure modes were assessed. The effects of

standard and abusive grinding and machining were determined. The machined samples demonstrated a fatigue life superior to that of the ground samples. The improvement was attributed to the compressive residual stresses measured in the machined samples.

1432 **Quantitative hardening-depth-measurements up to 4 mm by means of micromagnetic microstructure multiparameter analysis (3MA).** Dobmann, G.; Kern, R.; Altpeter, I.; Theiner, W. (Fraunhofer-Institut fuer zerstoerungsfreie Pruefverfahren (West Germany)). pp 1471-1475 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Results for quantitative hardening-depth-measurements at steel and cast iron surfaces using micromagnetic microstructure multiparameter analysis techniques are assessed. Two methods, incremental permeability and magnetic Barkhausen noise, were comparatively evaluated. Calibration curves are presented for both methods. Incremental permeability had a detectability up to 2 mm hardening depth while magnetic Barkhausen noise could be applied to a hardening depth of 4 mm. Profiles for both methods are illustrated.

1433 **Modeling of laser ultrasound generation in a weld pool.** Johnson, J.A. (EG & G Idaho, Inc., Idaho Falls (USA)). pp 1477-1484 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC07-76ID01570.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Finite element techniques were used to model laser generation of ultrasound and its propagation through a weld pool. Laser generation was modeled by assuming that the reactive force to the laser ablation of the liquid was a stress perpendicular to the pool surface. The pool boundary was assumed to be spherical. Sound wave propagation from the laser source through the pool boundary into the solid metal was calculated assuming property homogeneity in both the liquid and solid metal. Temperature gradient effects were neglected. The results are compared to a series of experiments on real and simulated weld pools.

1434 **Laser sound generation in a weld pool.** Carlson, N.M.; Johnson, J.A. (EG & G Idaho, Inc., Idaho Falls (USA)). pp 1485-1494 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC07-76ID01570.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Ultrasound was generated by a Q-switched Nd-YAG laser ablating the surface of a molten weld pool. A simulated glycerine-filled weld pool was used to generate signals similar to those in an actual weld pool. The source for most of these signals was confirmed with a ray tracing computer code. A predictive finite element code was also used to confirm the pressure and shear wave propagation and to determine the source of unknown signals. The dependence of the signal on the pool geometry can provide input to a closed-loop control system about the appropriateness of the pool geometry and depth produced by the selected welding parameters. A non-contact monitoring system using conventional ultrasonic transducers was shown to be feasible.

1435 **Acoustic emissions at an open crack.** Johnson, J.A. (EG & G Idaho, Inc., Idaho Falls (USA)). pp 1503-1511 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract AC07-76ID01570.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The finite element method was used to model acoustic emission in a problem whose complexities could not be handled using Green function methods. In particular the effect of a macrocrack on the received signal was investigated. The macrocrack was assumed to interact only as a geometric structure from which sound may reflect and mode convert and thereby complicate the signal at the receiving transducer. Numerical calculations of the acoustic emission field were compared to Green function results in a solid with no flaw. The computer program DYNA2D was used to simulate the acoustic field due to a dipole force near the tip of a simulated crack.

1436 **Acoustic emission from macro-microcrack configurations.** Zhang, C.; Achenbach, J.D. (Northwestern Univ., Evanston, IL (USA)). pp 1513-1519 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

In an earlier paper the effect of the proximity of a macrocrack on the acoustic emission generated by microcrack nucleation was analyzed under the restriction that the microcrack was located in the plane of the macrocrack. In this paper the microcrack may be arbitrarily oriented with regard to the macrocrack. The elastodynamic crack-opening displacements of both cracks were computed as numerical solutions of a set of coupled singular integral equations by use of the boundary element method. The fields were computed using the elastodynamic representation integral and the fast Fourier transform. Parametric studies showed the effect of microcrack orientation and distance from the macrocrack on the acoustically emitted fields.

1437 **Characterization of cracks in thick plates by Lamb wave diffraction studies.** Paffenholz, J.; Getting, I.C.; Spetzler, H.A. (Univ. of Colorado, Boulder (USA)). pp 1521-1523 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The diffraction of Lamb waves by two-and three-dimensional cracks in a plate were theoretically and experimentally studied for the purpose of developing a technique capable of detecting and characterizing weld cracks in plates. The dependence of the scattered signals on the dimension, angle of inclination, and burial depth of the cracks was analyzed. A surface displacement capacitive transducer was designed to determine minute surface displacements at ultrasonic frequencies. Measured displacements were compared with theoretical predictions.

1438 **Use of ultrasonic harmonic generation to determine crack opening conditions in compact tension specimens.** Yost, W.T.; Namkung, M.; Allison, S.G. (NASA-Langley Research Center, Hampton, VA (USA)). pp 1525-1529 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Two techniques for determining crack opening load, Load-Reduced Displacement and Load-Slope Change, are described and compared to a technique using harmonic generation to determine crack opening. The harmonic generation technique is based on the fact that as a crack in a compact tension specimen opens, harmonics are generated at the surfaces of the crack interface. Both fundamental and harmonic output were measured in a specimen of Al 2219-T851 that was previously cracked. Lithium niobate compressional undamped transducers were used both as sources and receivers. Harmonic output was measured and plotted as a function of load. Results are graphed and show agreement with theoretical calculations using finite element analysis.

1439 **Eddy current measurement of density during hot isostatic pressing.** Wadley, H.N.G.; Kahn, A.H.; Gefen, Y.; Mester, M. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 1589-1598 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An eddy current sensor was developed to measure dimensional changes, and thus density, during the hot isostatic pressing of powders in metal canisters. The sensor was used to measure densification of copper and to compare the experimental data with that predicted from hot isostatic pressing maps developed by Ashby et al. The comparison for the first cycle of tests indicated that the maps could be tuned using sensor data to accurately predict the densification trajectory. The possibility of coupling sensor data with predictive modeling to achieve better process control for hot isostatic pressing was assessed.

1440 **Eddy current sensor for the measurement of resistivity and temperature of aluminum rod during extrusion processing.** Kahn, A.H.; Mester, M.L. (National Bureau of Standards, Gaithersburg, MD (USA)). pp 1599-1605 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An eddy current sensor which performs on-line measurement of resistivity and converts the measurement to the corresponding temperature has been developed for process control purposes in aluminum rod extrusion. The integration of the sensor into an automated control system is discussed. On-line feedback is used to regulate extrusion speed. The temperature measurement is also be used to control the furnace which prepares the billets for the extrusion cycle. Results are presented for laboratory tests and a plant demonstration of temperature measurement on several extrusion shapes.

1441 **Laser-ultrasonics for industrial applications.** Monchalin, J.; Aussel, J.; Bouchard, P.; Heon, R. (National Research Council of Canada, Boucherville, Quebec (Canada)). pp 1607-1614 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Several experimental techniques are presented which demonstrate the industrial applications of laser ultrasonics particularly in the steel and aeronautic industries. A method was evaluated for increasing the receiving sensitivity of hot carbon steel by using laser surface cleaning to remove the oxide layer. Laser ultrasonics was also shown capable of detecting delaminations in curved fiber-reinforced composites without the necessity of precise alignment procedures. Ultrasonic images of delaminations in composite panels were also obtained.

1442 **Remote laser system for material characterization at high temperatures.** Dewhurst, R.J.; Edwards, C.; McKie, A.D.W.; Palmer, S.B. (Univ. of Hull (England)). pp 1615-1622 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A contactless nondestructive technique is described which uses lasers to generate and detect ultrasound and is used to study the variation in acoustic velocity as a function of temperature. Results are presented for the change in longitudinal velocity with increasing temperature in polycrystalline samples of Dural, aluminum, AISI-310 stainless steel, iron, and graphite. Waveform analyses are performed for the five samples and the results are graphed. The acquisition system uses a Q-switched Nd:YAG laser and a Tektronix MS4101 minicomputer.

1443 **Ultrasonic transducer characterization station.** Jolly, W.D.; Bruton, F.A.; Fedor, C. (Southwest Research Institute, San Antonio, TX (USA)). pp 1631-1638 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A portable and low cost ultrasonic transducer characterization station was developed to test ultrasonic transducers against their performance specifications. The station characterizes the pulse-echo response of immersion and contact transducers using six primary performance indicators: beam profile, squint angle, sensitivity, input impedance, center frequency, and bandwidth. The station serves as a common basis of comparison between manufacturer and purchaser and as a means of testing transducer performance in the field. Software design aids incorporated in the station facilitate the development of new designs along with the improvement of existing designs.

1444 **Analysis of a semi-automatic system for the ultrasonic measurement of texture.** Wormley, S.J.; Thompson, R.B.; Li, Y. (Iowa State Univ., Ames (USA)). pp 1639-1646 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An error analysis was conducted for a semi-automatic system for the measurement of texture in rolled metal plates. The errors were found to be on the same order but somewhat greater than fundamental limits based on the time sampling procedure used. The system uses ultrasonic velocity measurements to determine the crystallite orientation distribution functions. The theory behind the system and its technique is briefly outlined. The error analysis gives a worst case estimate of the orientation distribution coefficients (ODCs) determined by the system signal parameters. An experimental error evaluation was also conducted by comparing the ultrasonic data against data for x-ray and neutron diffraction for ODCs.

1445 **Design of a system of inspection assisted by microprocessor (SIAM) for adhesive bonded composite structures.** Arnaud, J.L.; Floret, M.; Lecuru, D. (Aerospatiale Central Lab., Sureses (France)). pp 1647-1652 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An ultrasonic system for inspecting aircraft components made of composite bonded structures was developed for nondestructive evaluation during component fabrication. Operating requirements for the system under factory conditions are described. The SIAM concept is defined and its design described. Four ultrasonic sensors are connected to a multiplexed thickness measurement unit which is microprocessor controlled. The SIAM system was installed in the Aerospatiale factory where its efficiency and reliability were assessed. Illustrations of the system and its display images are provided.

1446 **Real-time ultrasonic imaging system (ARIS) for manual inspection of aircraft composite structures.** Hamlin, D.R.; Jacobs, B.M.; Peterson, R.H.; Van der Veer, W.R.; Spinks, R.L. (Southwest Research Institute, San Antonio, TX (USA)). pp 1653-1660 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

ARIS was designed to permit routine day-to-day examinations of composite structures using established manual ultrasonic testing techniques while providing automated data recording, processing, and analysis functions. The system is portable, can be shipped and quickly assembled at the inspection site, and provides

real time coverage and processed data displays. It has successfully completed a series of field site evaluations and is currently in production. Pulse-echo and through-transmission images from wing and stabilizer composites are illustrated. Details of its purpose, design, and validation testing are given.

1447 **Compact EMAT receiver for ultrasonic testing at elevated temperatures.** Burns, L.R.; Alers, G.A.; MacLauchlan, D.T. (Magnasonics, Inc., Albuquerque, NM (USA)). pp 1677-1683 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Recent developments are covered in the design of a water-cooled EMAT receiver to be used in conjunction with a pulsed laser for measuring the transit time of ultrasonic waves through a thick strand of steel as it emerges from a continuous casting furnace. Ultrasonic, magnetic, electronic, and thermal design parameters are discussed. Cooling requirements and design solutions for the magnet cooling system are outlined. The EMAT was tested on a sample of stainless steel ten inches thick in a tube furnace at 500°C. Results are plotted for signal generation and echo amplitude.

1448 **Automated system for mapping autohesion and other joining related defects in polyethylene heat-fused pipe joints.** House, L.J. (Battelle Columbus Div., OH (USA)). pp 1685-1694 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

An automated ultrasonic system for mapping bond defects in gas distribution pipes was developed. The operational requirements included automated defect data acquisition and interpretation, accommodation of 2-inch through 4-inch pipe diameters, range sensitivity to polyethylene molecular weights associated with gas piping materials, and portability. The system uses a multi-element transducer array and is microprocessor controlled. Test results are plotted.

1449 **Pulsed eddy current method for examining thin-walled stainless steel tubing.** Pickett, C.A.; Koerner, D.W.; Deeds, W.E.; Dodd, C.V. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). pp 1695-1702 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A high-speed pulsed eddy current system was designed and built for multiple property measurements at a bandwidth of 20 Mhz. The system is capable of detecting defects as small as 0.0006 inch in depth on either the interior or exterior surfaces of thin-walled stainless steel bellows tubing. Computer algorithms were created to automatically size and locate defects. The system is fully automated and capable of making accept/reject decisions. The feasibility of the method and the inspection capability of the instrument are discussed. Schematics of the instrument are included and performance results are plotted.

1450 **Quantitative eddy current variants for micromagnetic microstructure multiparameter analysis (3MA).** Dobmann, G.; Becker, R.; Rodner, C. (Fraunhofer-Institut fuer zerstoerungsfreie Pruefverfahren (West Germany)). pp 1703-1707 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Recent developments are described in eddy current testing using cup coils rather than circumferential coils in 3MA NDE. Two new eddy current approaches are presented. One method meters the changes in electric conductivity and magnetic permeability and uses finite element modeling to calibrate cup coil impedance. The calculated mesh is stored in the memory of a microprocessor-controlled meter which measures the impedance of the coil. The second method is based on impedance spectroscopy and is used in the characterization of layered microstructures. Both techniques use ferrite cup coils rather than air coils. Results are plotted.

1451 **Application of eddy current principles for measurement of tube centerline deflection.** Chern, E.J. (Martin Marietta Labs., Baltimore, MD (USA)). pp 1709-1714 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A study is discussed in which the eddy current lift-off and edge effect principles were applied to the development of a measuring device for sensing tube deflection. Methods are presented for signal reduction and interpretation which were used to process the eddy current signal into true deflection dimensions and to derive a radius of curvature calculation using an arbitrary set of three deflection measurements. The advantages and drawbacks of using the eddy current device for measuring tube centerline deflections are assessed. System configuration and performance are given along with the results of computerized experiments to test the algorithms.

1452 **Recent developments in the Ames Magnetic Testing Facility.** Jiles, D.C. (Iowa State Univ., Ames (USA)). pp 1715-1722 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The development of a multiparameter magnetic inspection system is discussed. The system is being designed to coordinate four separate measurements - magnetostriction, the Barkhausen effect, magnetic induction, and magnetoacoustic emission - as well as the range of parameters these measurements generate. Consequently, the system can generate approximately fourteen separate pieces of information about the magnetic state of a material. This paper describes the background and progress to date for the system, including the control functions, data acquisition, and analysis software, and presents preliminary results for tests conducted on AISI 1000, 4130, and 4140 steels. Plans for future work are outlined.

1453 **Near-real-time radiography detects 0.1% changes in areal density with 1-millimeter spatial resolution.** Stupin, D.M. (Los Alamos National Lab., NM (USA)). pp 1723-1730 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The use of digital subtraction radiography for density and flaw detection was demonstrated using a phantom that duplicates x-ray absorption in an integrated circuit with a plastic case. The phantom consisted of stacked polyethylene sheets, aluminum and silicon films, and thin aluminum circuits etched onto the top of the silicon wafer. An aluminum step wedge was placed over the phantom. An x-ray image of the sample was cast onto a television camera, digitized, and sent to a PDP computer, where the 128-frame average of the phantom image was subtracted from the 128-frame average of the phantom-and-step image. The resulting image was then transferred to a video monitor. Two-micrometer tungsten wires were also imaged. The system and its performance and sensitivity are described and illustrated.

1454 **Digitization of NDT radiographs using a laser scanner for improved productivity.** Graeme, W.A. Jr. (E. I. du Pont de Nemours & Co., Inc., Wilmington, DE (USA)). pp 1731-1736 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The digitization of radiographs is assessed as a method for eliminating the bottlenecks inherent in the exposure and wet processing times required by x-ray film. Comparisons were drawn between real time digital radiography and film radiography for such parameters as speed, cost, spatial resolution, digital image interpretation, and image archiving. Performance, range, and resolution specifications for a laser digital scanner are listed. Information losses were evaluated. Improved defect recognition and image analysis and reduced analysis time are among the advantages cited for digital radiography.

1455 **Application of ultrasonic POD models.** Gray, T.A.; Amin, F.; Thompson, R.B. (Iowa State Univ., Ames (USA)). pp 1737-1744 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A computer model has been developed which can simulate signals that would be obtained in scanned ultrasonic inspections of gas turbine engine components and can estimate the probability of detection (POD) of both crack-like and volumetric defects. The model explicitly incorporates the features of the inspection system, the component design, and the critical defects, and enables the POD of critical defects to be predicted as functions of both the inspection protocol and the design parameters. The ultrasonic POD model is reviewed and its utility is illustrated by way of simulations which address the evaluation of tradeoffs in NDE system selection for inspection of a specific component design.

1456 **Prediction of the probability of eddy current flaw detection.** Beissner, R.E.; Bartels, K.A.; Fisher, J.L. (Southwest Research Institute, San Antonio, TX (USA)). pp 1753-1760 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—). Contract W-7405-ENG-82.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The use of computer simulation in predicting the probability of detection (POD) and the probability of false alarm (PFA) using eddy current testing techniques was demonstrated. Methods used to generate the signal and noise data required for the model are outlined. The inspection geometry and field mapping were provided by an eddy current version of the boundary element method and by the reciprocity theorem which was used to relate probe impedance change caused by the flaw to fields on the flaw surface. The three-dimensional model accurately computed flaw response maps and flaw signal amplitudes. Calculations of signal against noise and POD against PFA are plotted and analyzed.

1457 **Statistical evaluation of NDE reliability in the aerospace industry.** Hovey, P.W.; Berens, A.P.. (Univ. of Dayton Research Institute, OH (USA)). pp 1761-1768 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

The probability of detection (POD) function is the principle evaluation tool for NDE reliability in the aircraft industry. Two statistical methods have been developed for estimating the POD function as a function of crack size. Linear log logistic analysis is used for pass/fail data while the response signal versus crack length analysis is used for data that includes the raw response for each flaw. The techniques used for estimating the false call rate are geared more toward operator performance than evaluation of the influence of NDE on system reliability. The techniques are consistent with damage tolerant design and structural maintenance philosophies of the industry.

1458 **Methodology for analysis and characterization of nondestructive inspection capability data.** Rummel, W.D.; Christner, B.K.; Long, D.L. (Martin Marietta Astronautics Group, Denver, CO (USA)). pp 1769-1776 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Methods are evaluated for assessing the reliability of NDE data and integrating probability of detection (POD) and probability of false alarm (PFA) tools into false call rate considerations and accept/reject decision levels. The methods include signal-noise analysis, binomial grouping analysis, maximum likelihood analysis, and response signal versus crack length analysis. POD curves generated by these methods are compared and a specificity analysis is described which presents the relationship between POD and PFA as a function of the inspection acceptance threshold level. A sample specificity diagram for an eddy current hole inspection procedure is given.

1459 **Proficiency evaluation of NDE personnel utilizing the ultrasonic methodology.** Davis, M.K. (Nondestructive Inspection and Testing Section, Kelly Air Force Base, TX (USA)). pp 1777-1789 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A testing method was developed and results of its implementation were evaluated for assessing the proficiency of NDE technicians in the ultrasonic evaluation of F-100 stage 2 compressor blades. The subjects were technicians of the Structural Assessment Testing Facility in the Engine Division of the SA-ALC. The test consisted of two phases in which different blade groups with artificially induced fatigue cracks were used. Individual test results are tabulated and the statistical and matrix mathematics used for test data evaluation are presented. Relative operating characteristic curves were plotted. The viability of the method toward establishing general training program requirements is discussed.

1460 **Wednesday evening session XIX. Town meeting on a working group in NDE.** Chimenti, D.E.; Rummel, W.D.; Thompson, R.B. (Wright-Patterson Air Force Base, OH (USA)). pp 1799-1817 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

This paper represents the edited transcripts of presentations and discussions which took place among a group of NDE conference participants during a problem session. The focus of the session was to weigh the possibility of creating a national society or organization for NDE research and engineering. Results from a national survey conducted among NDE professionals in which both individual and affiliation data were acquired were presented and evaluated. The potential of a society for reducing publication and research redundancy and for streamlining NDE research and development work was discussed. An ad hoc working group was elected and a charter was drawn up as a preliminary attempt at establishing an affiliation.

1461 **Review of progress in quantitative nondestructive evaluation. Volume 7.** Thompson, D.O.; Chimenti, D.E. (eds.). New York, NY; Plenum Press (1988). 1854p. (CONF-870691—). Plenum Press, 233 Spring Street, New York, NY 10013.

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

Research in nondestructive evaluation theory, techniques, and equipment for materials ranging from metals to composites is described in the 218 papers contained in these conference proceedings. The topics covered include the fundamentals of ultrasonic, eddy current, and thermal wave testing; imaging, tomography, and inversion; sensors and probes; image enhancement and signal processing; adhesive bond and composite testing; electronic materials and device evaluation; materials characterization for aspects such as microstructure, bonds and interfaces, acoustoelasticity, stress, and texture; ferromagnetic materials and weldment testing; crack and deformation evaluation; nondestructive applications in process control; and nondestructive evaluation systems and reliability assessment.

1462 **Vibration sensing method and apparatus.** Barna, B.A. US Patent Application 6-070,763. 7 Jul 1987. 19p. Contract AC07-76ID01570. NTIS, PC A03/MF A01.

A method and apparatus for nondestructive evaluation of a structure is disclosed. Resonant audio frequency vibrations are excited in the structure to be evaluated and the vibrations are measured and characterized to obtain information about the structure. The vibrations are measured and characterized by reflecting a laser beam from the vibrating structure and directing a substantial portion of the reflected beam back into the laser device used to produce the beam which device is capable of producing an electric signal containing information about the vibration. 4 figs.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 631, 1090, 1101, 1116, 1156, 1263, 1414, 1453, 1500, 1566, 1578, 1596

1463 **(AD-A—195683/8/XAB) Millimeter-wave generation by relativistic electron beams. Final report, 1 November 1986-31 October 1987.** Kuo, S.P. (Polytechnic Univ., Farmingdale, NY (USA). Weber Research Inst.). Oct 1987. 8p. NTIS, PC A02/MF A01.

Under the support of this equipment grant, the facilities of the Plasma laboratory of the Institute used for an on-going research program funded by the AFOSR were upgraded. The research program bears the scientific goal to develop a high-power, compact microwave device carrying good output efficiency. A cusptron device is thus designed to meet the requirements. This device utilizes the negative-mass instability for the resonant interaction between an axis-encircling electron beam and the modes of a slotted cylindrical waveguide. This beam configuration is prodiced by passing an electron beam through cusp magnetic field and maximizes the finite Larmor-radius effect for harmonic cyclotron-resonance interaction. Further, the slotted boundary introducing a periodic fringe field near the orbits of the electron beam, thus, enriches the resonant harmonic contents of the rf fields as experienced by the gyrating electrons.

1464 **(AD-A—196971/6/XAB) Microcomputer-network architecture for range-instrumentation applications. Final report, 16 September 1987-13 March 1988.** Belzer, M.R.; Cho, Y.M. (Mentor Technologies, Inc., Bayside, NY (USA)). 13 Mar 1988. 58p. NTIS, PC A04/MF A01.

VLSI technology has been developed to the point where special-purpose processors may be concatenated to form supercomputers with far greater throughput rates than uniprocessor machines. MTI has developed a parallel form of the conventional Kalman filter that is well suited to being implemented in a multiprocessing environment. Moreover, our Decentralized Square Root Information Filter (DSRIF) has several very unique features which could be incorporated into the design of an integrated test-range tracking system with much improved performance over existing methods. Phase I research demonstrated feasibility of the DSRIF as a means for solving the linear least-squares estimation problem in decentralized form. Also, an extended form of the DSRIF was derived and successfully used to track real Multiple Rocket Launch System Data provided by the White Sands Missile Range.

1465 **(DPST—87-233) Radiation hardened electronics.** Goosey, M.H. (Savannah River Lab., Aiken, SC (USA)). 21 Jan 1987. Contract AC09-76SR00001. 14p. NTIS, PC A03/MF A01. Order Number DE89001401/JAW.

The Robotics Technology and Development Groups have on-going programs to exploit the use of robots to reduce or eliminate radiation exposure to personnel. In robots to be used in high gamma radiation fields, consideration must be given to the effects of the radiation on on-board electronics systems. A study was undertaken to determine the types of microelectronic devices that were suitable for this environment and how their service life could be extended by shielding.

1466 **(LLL/M—190-Vol.1) Associated Western Universities summer graphics project: Volume 1, Circuits and systems.** Miller, E.K.; Cole, R.W. (eds.). (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 78p. NTIS, PC A05/MF A01. Order Number DE89001555/JAW.

This document is a collection of texts to accompany computer-animated movies that were developed during the summers of 1984-1986 at Lawrence Livermore National Laboratory by faculty members visiting from six universities. The project entitled "Computer and Computer Graphic Applications in Engineering Education" was funded by The American Western Universities, Inc. and the US Department of Energy. The original goal of the project was to promote the use of computers and computer graphics in science and engineering education through the development of software for interactive modeling and graphical display of appropriate problems and the production of computer-generated films for displaying physical phenomena. This project brings together physics and engineering faculty to produce computer-animated videotapes of ideas and processes that are very difficult to describe in a lecture, but would benefit greatly from an animated representation. Examples are given in Circuits and Systems.

1467 **(SAND—88-0946) Stress driven diffusive voiding of aluminum conductor lines: A model for time dependent failure.** Yost, F.G.; Romig, A.D. Jr.; Bourcier, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1988. Contract AC04-76DP00789. 109p. NTIS, PC A06/MF A01. Order Number DE89001057/JAW.

Cracking or voiding of passivated aluminum conductor lines in integrated circuits has been observed by many workers since 1984. This problem has been brought on by the trend in the microelectronics industry to miniaturize circuitry. Most reports on the subject attribute the cause to diffusion creep. This report points out certain difficulties with this conclusion and presents the essential features of a related failure mechanism which is termed "constraint cavitation." A numerical stress analysis is presented to illustrate stress gradients and their sources. These stress gradients are known to drive mass transport which leads to void formation. Equations are presented which describe the growth rates of two void morphologies. A definition of failure is made and the time to failure is calculated and the relationship with line width and temperature is given. With properties of aluminum taken from the literature, it will be shown that the calculated failure time is in very good agreement with experimental data. 71 refs., 36 figs., 4 tabs.

1468 **(SAND—88-1668C) Oxides and oxynitrides of porous silicon.** Tsao, S.S.; Guilinger, T.R.; Kelly, M.J.; Knapp, J.A.; Stein, H.J.; Barbour, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-881155—2). NTIS, PC A02/MF A01. Order Number TI89000301/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

In this paper we present preliminary results on the formation of oxynitride films by nitridation of porous silicon in ammonia. We compare the composition and electrical breakdown properties of nitrided and oxidized porous silicon. We show that an ammonia anneal at 1000{degree}C for 1 hour can convert porous silicon into a porous oxynitride layer with substantial amounts of nitrogen ({approximately}22 at. %). However, this ammonia treatment by itself leads to insulating layers with poor electrical breakdown properties.

Combining the ammonia treatment with thermal oxidation increases the breakdown strength of the porous silicon-based oxynitride films. 4 refs., 2 figs.

1469 **(SAND—88-2220) SPEED [Short Pulse Experimental Electron Device] pulse power manual.** Klingler, R.S.; Mikkelson, K.A. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1988. Contract AC04-76DP00789. 55p. NTIS, PC A04/MF A01. Order Number DE89001844/JAW.

SPEED is a weapons effects simulator used to test electronics components and small subsystems. This manual describes the accelerator, diode, theory of operation, diagnostics and operational procedures. It is intended to provide an introduction for users and background information for operators. 4 refs., 13 figs., 1 tab.

1470 **(SAND—88-2972C) Removing seismometer effects using inverse filtering techniques.** Kitzinger, D.P.; Breding, D.R.; Etter, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-8810202—1). NTIS, PC A02. Order Number DE89001851/JAW.

From 22. Asilomar conference on signals, systems and computers; Pacific Grove, CA, USA (30 Oct 1988).

This paper summarizes the results of using inverse filtering techniques to remove seismometer effects from data which had been distorted and split into separate components by analog filters. A digital frequency sampling filter scheme was used to design the inverse filter. In this scheme a number of small elemental filters were summed. Special care had to be taken in the design of the inverse filter since components sampled at different frequencies were recombined to form the new composite signal. 5 refs. 12 figs.

1471 **(STEV-VIND—88-17) Real time clocks for IBM PC/AT.** Landkvist, B. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). (Statens Energiverk, Stockholm (Sweden); Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jan 1988. 16p. (In Swedish). (FOA-C—20693-2.7). NTIS (US Sales Only), PC A03/MF A01. Order Number DE8755102/JAW.

The report describes a computer card with three programmable real time clocks to be placed in Personal Computer IBM PC/AT, aimed to be used in rapid control system. An example of a program is also given.

1472 **(UCID—19080-87) Engineering Research Division publication report, calendar year 1987.** Holten, M.L.; Globig, E.L. (comps.). (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01. Order Number DE89001281/JAW.

Each year, the Engineering Research Division of Electronics Engineering has issued an internal report listing all formal publications produced by the Division during the calendar year. The listing is alphabetized by first author. If you wish to order a copy of the listed reports, please contact the author(s). Beginning in 1989, this report will be expanded to include formal publications originating from all divisions within Electronics Engineering during the previous calendar year.

1473 **High-speed InP-based In/sub x/Ga/sub 1-//sub x/As Schottky barrier infrared photodiode for fiber-optic communications.** Kim, J.; Li, S.S.; Figueroa, L.; Carruthers, T.F.; Wagner, R.S. (Department of Electrical Engineering, University of Florida, Gainesville, Florida 32611). *Journal of Applied Physics;* **64**: No. 11, 6536-6540(1 Dec 1988).

We report on a new high-speed InP-based In/sub x/Ga/sub 1-//sub x/As Schottky barrier photodiode for infrared detection. The photodiodes were fabricated on both p- and n-InGaAs epilayers. For this application, Schottky barrier height enhancement on InGaAs has been demonstrated. The photodiodes had responsivities as high as 0.55 A/W and quantum efficiencies of up to 45% in the range of 1.3—1.6 μm without antireflection coating. The response speed of photodiodes was measured by the impulse response and autocorrelation methods; rise times of 85 ps for p-InGaAs and 180 ps for n-InGaAs photodiodes were obtained. Recently, a barrier height enhancement of 0.35 eV was obtained in n-InGaAs photodiodes, resulting in a great reduction of leakage currents. This would lead to further improvement in the device performance of the photodiodes. Based on measured RC time constants, we estimate the intrinsic response speed to be 12 GHz for n-InGaAs and 18 GHz for p-InGaAs photodiodes. These results show that InP-based In/sub x/Ga/sub 1-//sub x/As Schottky barrier photodiodes can be very useful for high-speed infrared receivers in fiber-optic communications.

1474 **Pierce diode with an external circuit: Simulations in the linear regime.** Lawson, W.S. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **64**: No. 10, 4838-4842(15 Nov 1988).

The linear theory for the eigenfrequencies of the extended Pierce diode for resistive, capacitive, and inductive external circuits is tested via computer simulation with the p-smcapsd-smcapsw-smcaps1 code, and is verified to within the accuracy of the simulation (between 1% and 0.01% depending on the circumstances). The simulations were remarkably inexpensive in terms of computer time, and could have been performed on a personal computer.

1475 **Long life reference electrode.** Yonco, R.M.; Nagy, Z. US Patent Application 6-079,615. 30 Jul 1987. 15p. Contract W-31109-ENG-38. NTIS, PC A03/MF A01.

An external, reference electrode is provided for long term use with a high temperature, high pressure system. The electrode is arranged in a vertical, electrically insulative tube with an upper portion serving as an electrolyte reservoir and a lower portion in electrolytic communication with the system to be monitored. The lower end portion includes a flow restriction such as a porous plug to limit the electrolyte release into the system. A piston equalized to the system pressure is fitted into the upper portion of the tube to impart a small incremental pressure to the electrolyte. The piston is selected of suitable size and weight to cause only a slight flow of electrolyte through the porous plug into the high pressure system. This prevents contamination of the electrolyte but is of such small flow rate that operating intervals of a month or more can be achieved. 2 figs.

1476 **Triple-material stress-strain resistivity gage.** Stout, R.B. US Patent Application 6-051,560. 19 May 1987. 18p. Contract W-7405-ENG-48. NTIS, PC A03/MF A01.

A triple material piezoresistive gage provides multi-component elastic stress or strain measurements. Thin foils of three piezoresistive materials, e.g., ytterbium, manganin, and constantan, are configured in a nested serpentine rectilinear grind or other grind arrangement and embedded in a medium, preferably normal to the direction of shock wave propagation. The output of the gage is a resistivity change history for each material of gage. Each resistivity change is independent of the others so that three diagonal components of the elastic stress or strain tensor can be calculated form the resistivity measurements. 4 figs.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 333, 391

1477 **(PB—88-868864/XAB) Incineration studies. October 1985-September 1988 (Citations from the Compendex data base). Report for October 1985-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 114p. NTIS PC N01/MF N01.

Supersedes PB—87-866935.

This bibliography contains citations concerning incineration of municipal, industrial, agricultural, and shipboard wastes. Topics include incinerator design, air pollution control, materials and heat recovery, pyrolysis incineration, and economic evaluations. Some attention is given to waste-to-energy operations. (This updated bibliography contains 200 citations, 40 of which are new entries to the previous edition.)

1478 (SERI/CP—231-3355, pp 123-128) **Overview of thermochemical conversion of municipal solid waste.** Goodman, B.J. Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

The research program focuses its thermochemical conversion research on feedstock preparation, advanced combustion, and pyrolysis. To convert MSW into liquid or gaseous fuels, it must first be separated by mechanical systems into components. The products of sizing and separating include a solid fuel called fluff refuse-derived fuel (RDF). With additional processing, fluff RDF can be converted to densified RDF (dRDF) by pelletizing, briquetting, or extruding with or without binders, or into powdered RDF (pRDF) by adding an embrittling agent. dRDF is easier to store and transport and has better energy density than RDF. pRDF can be mixed with oil and burned in existing oil-fired boilers. In addition, materials can be recovered for recycling. Current research efforts on feedstock preparation include evaluation of pulsed air classifiers and shear shredders and preparation of densified and powdered fuels from MSW. Research efforts are also being pursued to investigate the potential of thermochemically transforming MSW into gasoline via two sequential steps: (1) converting feedstock into a biocrude liquid and (2) upgrading the biocrude by advanced catalytic processes to gasoline. Current efforts focus on evaluation of the basic mechanisms of pyrolysis, experimentation of fast pyrolysis, demonstration of a novel pyrolysis mill, and determination of the dynamics of heat transfer and fluid flow.

1479 (SERI/CP—231-3355, pp 129-140) **Advanced testing of pulsed air classifier and evaluation of shear shredders.** Mayberry, J.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

Idaho National Engineering Laboratory (INEL) is currently conducting research in the mechanical processing of Municipal Solid Waste (MSW). The research areas for FY-87 and FY-88 includes advanced testing of the pulsed air classifier and the evaluation of shear shredders. The research effort on the pulsed air classifier involves testing an active pulsed air classifier and a passive pulsed air classifier at Duke University. The variables tested under the current funding includes determining the effects of feed rate and height of the classifier on the efficiency of operation. A prototype pulsed air classifier is also being designed and built. The research effort on the shear shredders involves testing shear shredders in operation for various design configuration and operational conditions in order to establish a database on shear shredders.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 532, 825, 1099, 1218, 1222, 1223, 1224, 1296, 1301

1480 **(PB—88-239074/XAB) Industrial-boiler low NOx combustion retrofit cost algorithm development. Final report.** Johnson, K.L. (Radian Corp., Research Triangle Park, NC (USA)). Aug 1988. 50p. NTIS, PC A03/MF A01.

This report documents the development of the low-NOx combustion cost algorithm for industrial boilers. It describes the methods used to develop capital and annualized costs. The boiler size range examined covers units with capacities ranging from 100 to 1300 million Btu/hr heat input for coal firing, with oil- or gas-fired units as small as 10 million Btu/hr. All costs presented are in June 1985 dollars. The algorithm will become part of the Industrial Combustion Emission (ICE) model being developed for the National Acid Precipitation Assessment Program (NAPAP). Low-NOx combustion is one of several technologies being developed specifically for application to existing uncontrolled boilers.

1481 **(STU-I—618-1987) Fundamental combustion research.** Holmstedt, G. (Swedish National Board for Technical Development, Stockholm). Jan 1987. 50p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755109/JAW.

The report presents a concise proposal for the research program sponsored by the Swedish Board for Technical Development. The program is presented under the following headings: -Subject related research; Chemical physics, Surface problems and catalysts, Fluid flow, Diagnostics. -General combustion phenomena; Fuel know-how, Combustion kinetics, Pre-mixed flames and diffusion flames, Transients and conditions of stability, Pyrolysis - gasification, Combustion of sprays and pulverized fuels, Energy transfer, Forming of air pollutants and air pollution control. -Particular combustion phenomena; Piston engines, Combustion equipment, Gas turbine combustion chambers, Grate firing, Fluidized bed. (O.S.).

1482 **(SVF—292) Inventory of materials experiences from Swedish fluidized bed combustors.** Haeggblom, E. (Studsvik Energiteknik AB, Nykoeping (SE)). (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Energiteknik AB, Nykoeping (Sweden)). Mar 1988. 26p. (In Swedish). (STUDSVIK-EX—87-54). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755110/JAW.

Materials related experiences, such as wear and corrosion, have been investigated in commercial Swedish fluidized bed boilers. The results have been collected through a questionnaire. The investigation mainly concerns how heat exchanging surfaces have withstood attacks. But also uncooled metallic internals are included. Bricks and ceramic masses are only shortly mentioned.

1483 **(SVF—294) Accumulator system for operative equalizing.** Koehler, B. (Bertil Koehler Energikonsult HB, Taeby (SE)). (Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden)). Mar 1988. 88p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755111/JAW.

A 'soft coupling' means an equalizing accumulator in the pipe system. When momentarily there is an excess of heat in the plant, hot water will run into the accumulator, whereas when there is a shortage of heat the accumulator delivers heat to the consuming system. When a district heating plant is fired with wood chips it happens that the heat generation in the boiler does not change fast enough. As a consequence the design data - temperature and pressure - can temporarily be exceeded as the boiler can not be regulated down fast enough. Such incidents can for instance cause leakages in the district heating pipe lines. In order to avoid these complications a 'soft coupling' can be installed between the energy producer and the pipe system. More time will then be obtained to solve the different problems and the heating process can thereby be optimized and reach a high efficiency. The advantages of an accumulator can be summarized as follows: 1. Higher efficiency in the boiler. 2. Lower fuel costs with regard to the possibility to exploit a boiler with cheaper fuel for a longer time. 3. Better availability. 4. Less strain on the material in the plant. 5. Lower maintenance costs. By avoiding one single break-down in the plant or in the district heating system the cost of an accumulator can quite easily be justified.

1484 **Effects of a high-velocity jet on fundamental particle-separation characteristics.** Zhang, J.Y.; Zhang, B.J.; Chitester, D.C. (Institute of Coal Chemistry, Academia Sinica, P.O. Box 165, Taiyuan, Shanxi (CN)). *Industrial and Engineering Chemistry Research;* **27**: No. 7, 1277-1281(Jul 1988).

The high velocity jet region of a jetted fluidized bed plays an important role in momentum, mass, and heat transfer in the bed. A two-dimensional, fluidized-bed cold model equipped with a high-velocity jet was constructed to study the role of this high-velocity region. Glass beads were used to simulate ash agglomerates, and millet and catalyst powder were used to simulate coal and char, respectively. The effect on particle separation of various operating parameters including jet geometry, jet velocity, and particle size and density was studied. From these experiments, some important information on particle separation was obtained. An optimal, jet-zone, geometric configuration was identified for efficient particle separation. A graphical representation of the particle-separation process for heterogeneous solids was developed. Also, empirical equations were developed to calculate initial-separation velocity and critical-separation velocity.

1485 **Optimization of a swirl burner for pulverized-wood fuels.** Adams, T.N.; Raymond, D.R.; Schmid, C. *Tappi;* **71**: No. 5, 91-96(May 1988).

Development and optimization of swirl burners has been the task of the International Flame Research Foundation (IFRF) for the past three decades. A wide range of optimization criteria, from stability, to efficiency, to environmental protection, has been applied by the IFRF to an even wider range of solid, liquid, and gaseous fuels. Recognizing this expertise, the International Energy Agency (IEA) funded an experimental program at the IFRF in 1984 to collect fundamental data for wood-fines burning. Five of the member countries of the IEA participated in this program: The United States, Canada, Noray, Sweden, and Finland. The contract was administered through Norsk Dampkjelforening of Oslo, Norway. This program's objective was to optimize a swirl burner for wood waste. This was done by identifying the burner aerodynamics that produced the most stable and efficient combustion for a range of wood fuel sizes and moisture contents. This article presents a summary of the IFRF program, test results, and significant findings.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 504

1486 **(IFP—35-796) Hydraulic fracturing: calculation of induced fracture propagation in rocks.** Bouteca, M. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison; Ecole Nationale Superieure des Mines, 75 - Paris (France)). 30 Sep 1987. 193p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88755326/JAW.

The aim of this work is the calculation of the size of a fracture obtained by fluid injection. Main parameters are defined and two methods are proposed for the numerical solution of equations of mechanical equilibrium by the method of integral equations, allowing the analytic calculation of propagation, fracture diameter and stress intensity factor. Mechanical equilibrium of fracture and pressure distribution are coupled. The tridimensional model of fracture propagation is compared to a reference model from the literature.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 103

1487 **(IFP—35-749) Contribution to the experimental study of heave damping of semi-submersible platforms.** Le Marchand, E. (Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)). Oct 1987. 128p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88754981/JAW.

Damping of hydrodynamic forces on a structure with a rectangular cross section is studied. A 1/40 th scale model is realized for the experimental study. The scale and the frequency range chosen allow damping analysis for Reynolds numbers greater than previously studied. Dependence of drag damping on the parameter of viscosity beta is evidenced for low Keulegan numbers. The mean drag coefficient is very much influenced by geometry of longitudinal edges. Superposition of a monochromatic swell to low frequency heave (natural period of offshore platform studied) increases heave drag.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 528, 531

1488 **(GKSS—88/E/23) ARGOS - mobile lidar for remote air pollution measurements.** Bisling, P.; Weitkamp, C.; Lahmann, W.; Michaelis, W.; Birkmayer, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik; Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (Germany, F.R.)). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik; Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (Germany, F.R.)). 1988. 8p. (CONF-8802114—). Reprint from: Remote sensing of atmosphere and oceans. Vol. 2. Canberra: Australian Defence Force Academy, 1988, p. 63(1)-63(6).

From 4. symposium of the International Society of Acoustic Remote Sensing and 2. Australasian conference on the physics of remote sensing of atmosphere and ocean; Canberra, Australia (16 Feb 1988).

ARGOS is a compact, mobile, moderately-priced differential absorption and scattering lidar for the measurement of immissions, emissions, and transport values of sulfur dioxide, nitrogen dioxide, or ozone. Particular emphasis has been laid on ease of operation and minimum maintenance requirements.

4250 Power Cycles

REFER ALSO TO CITATION(S) 780, 836, 1303

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 1516, 1589, 2642

1489 **(BNL—41716) A High Intensity Hadron Facility, AGS II.** Lee, Y.Y.; Lowenstein, D.I. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-880862—1). NTIS, PC A02/MF A01. Order Number DE89001106/JAW.

From BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY, USA (28 Aug 1988).

We have present one of several possibilities for the evolution of the AGS complex into a high intensity hadron facility. One could consider other alternatives, such as using the AGS as the Collector and constructing a new 9-30 GeV machine. We believe the most responsible scenario must minimize the cost and downtime to the ongoing physics program. With a stepwise approach, starting with the Booster, the physics program can evolve without a single major commitment in funds. At each step an evaluation of the funds versus physics merit can be made. As a final aside, each upgrade at the AGS and Booster is presently being implemented to support an interleaved operation of both protons and ions. 1 fig., 6 tabs.

1490 **(FNAL/C—88/114) Prospects of TEVATRON upgrade.** Syphers, M.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 31 Aug 1988. Contract AC02-76CH03000. 17p. (CONF-8806232—2). NTIS, PC A03. Order Number DE89001152/JAW.

From 7. topical workshop on proton-antiproton collider physics; Batavia, IL, USA (20 Jun 1988).

Following a brief review of the 1987 Fermilab collider run and the present status of the 1988 run, upgrade plans for the near-term (1988-1992) are described. For further luminosity upgrades beyond 1992, several scenarios are currently being discussed, one of which includes the construction of two new 20 GeV rings which could raise the proton-antiproton collider luminosity by a factor of 50 over the original Tevatron I design. Another possible project, the construction of a high luminosity proton-proton collider, has

also been investigated in detail. A third scenario, involving a new Main Injector to replace the Main Ring and a new higher energy superconducting synchrotron, is presently being examined. It is hoped that this will result in a proposal to be submitted to DOE for FY91. The major issues concerning these options are presented. 8 figs., 1 tab.

1491 **(FNAL/C—88/137) Transition section between a 200 MHz drift tube linac and a high gradient coupled cavity linac for the Fermilab upgrade.** MacLachlan, J.A.; Mills, F.E.; Oleksiuk, L.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). 3 Oct 1988. Contract AC02-76CH03000. 4p. (CONF-881049—25). NTIS, PC A02. Order Number DE89001603/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

The transition at 116 MeV between tank 5 of Fermilab's 200 MeV H/sup {minus}/ linac and a proposed 400 MeV 805 MHz side coupled linac requires both longitudinal and transverse phase plane beam matching. The design of the transition section is based on a 90{degree} longitudinal phase oscillation at intermediate gradient combined with a sufficient number of quadrupoles to match transverse beam ellipses and simultaneously limit extreme beam width in the matching process. Both doublet and FODO variants of the transverse matching are satisfactory in concept; the choice is part of current design work. 4 refs., 2 figs., 3 tabs.

1492 **(FNAL/C—88/138) Reference design for the Fermilab linac upgrade.** MacLachlan, J.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). 3 Oct 1988. Contract AC02-76CH03000. 4p. (CONF-881049—24). NTIS, PC A02. Order Number DE89001604/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

Fermilab plans to increase the energy of its H/sup {minus}/ linac from 200 to 400 MeV as part of a program to enhance the operation of the Tevatron for both collider and fixed target operation. The principal motivation for the linac upgrade is to reduce the incoherent spacecharge tuneshift at injection into the booster synchrotron. Other parts of the program are required to fully exploit the linac upgrade, but immediate improvement should be seen in booster performance with consequent benefit for collider luminosity and probably fixed target intensity as well. Improved diagnostic and beam steering capabilities and the elimination of some of the obsolete triode power amplifiers are expected to lead to improved reliability and consistency in linac operation. The grade design has been presented in a conceptual design report. This paper treats the current evolution of the general design and principal parameters of the linac with little reference to components, supporting systems, conventional facilities, etc. 13 refs., 5 figs., 1 tab.

1493 **(FNAL-TM—1546) Third order TRANSPORT with MAD [Methodical Accelerator Design] input.** Carey, D.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 20 Sep 1988. Contract AC02-76CH03000. 62p. NTIS, PC A04/MF A01. Order Number DE89001280/JAW.

This paper describes computer-aided design codes for particle accelerators. Among the topics discussed are: input beam description; parameters and algebraic expressions; the physical elements; beam lines; operations; and third-order transfer matrix. (LSP)

1494 **(FNAL-TM—1547) NK Muon Beam.** Koizumi, G. (Fermi National Accelerator Lab., Batavia, IL (USA)). 28 Sep 1988. Contract AC02-76CH03000. 47p. NTIS, PC A03/MF A01. Order Number DE89002079/JAW.

The NK Muon Beam will be a modified version of the existing NT beam line. The decision to employ a modified version of the NT beam line was made based on considerations of cost and availability of the beam line. Preliminary studies considered use of other beam lines, e.g., the NW beam line, and even of moving the bubble chamber with its superconducting coils but were rejected for reasons such as cost, personnel limitations, and potential conflicts with other users.

1495 **(LBL—25235) Development of heavy ion induction linear accelerators as drivers for inertial confinement fusion.** Warwick, A.I.; Celata, C.; Faltens, A.; Fessenden, T.J.; Judd, D.L.; Keffe, D.; Kim, C.H.; Laslett, L.J.; Lee, E.P.; Meuth, H.; Rutkowski, H. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 3p. (CONF-880695—64). NTIS, PC A02/MF A01. Order Number DE89001320/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

There is a continuing study in the USA of the feasibility of an induction linac fusion driver, which would accelerate multiple heavy-ion beams through a sequence of pulsed transformers and amplify the beam current during acceleration. The driver cost could be $200/Joule or less and the cost of electricity in the range of .050-.055$/kWhr. As a next stage of development to assess the feasibility of this approach we propose an "Induction Linac Systems Experiment". This will test some of the technology and multiple-beam manipulations necessary for a fusion driver. 7 refs., 1 fig.

1496 **(SAND—88-2170C) RADLAC-II upgrade experiments.** Shope, S.L.; Frost, C.A.; Hasti, D.E.; Leifeste, G.T.; Mazarakis, M.G.; Poukey, J.W.; Smith, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 3p. (CONF-881049—22). NTIS, PC A02. Order Number DE89001223/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

The linear induction accelerator, RADLAC II, is being upgraded to produce a 20-MeV, 40-kA annular electron beam with improved beam quality. Previously, the accelerator produced a 15-MeV, 15-kA beam. Improvements in the pulsed power, injector design, and magnetic field have resulted in a faster rising, flat-topped voltage pulse. The first experiments used only the injector and produced a 5.3-MeV, 47-kA high quality annular beam that was transported in a 20-kG magnetic guide field to the location of the first 2.5-MV accelerating gap. The beam is now being transported and accelerated through two of the six accelerating gaps. The accelerating gaps are of a unique design that minimizes changes in the radial electric field to reduce the amplitude of radial oscillations. The quality of the accelerated beam will be measured through two gaps before adding the remainder of the accelerator. Simulations show that the beam quality will be maintained through the accelerator. The final accelerator will produce a 20-MeV, 40-kA annular high quality beam with a small perpendicular velocity component, v/sub perpendicular/, with β/sub perpendicular/c $<$ 0.2 c. 11 refs., 5 figs., 1 tab.

1497 **(UCRL—98553) Pulsed high-power beams.** Reginato, L.L.; Birx, D.L. (Lawrence Livermore National Lab., CA (USA)). Jun 1988. Contract W-7405-ENG-48. 5p. (CONF-880695—65). NTIS, PC A02. Order Number DE89001322/JAW.

From 1. European particle accelerator conference; Rome, Italy (7 Jun 1988).

The marriage of induction linac technology with nonlinear magnetic modulators has produced some unique capabilities. It is now possible to produce short-pulse electron beams with average currents measured in amperes, at gradients approaching 1-MeV/m, and with power efficiencies exceeding 50%. A 70-Mev, 3-kA induction accelerator (ETA II) constructed at the Lawrence Livermore National Laboratory incorporates the pulse technology concepts that have evolved over the past several years. The ETA II is a linear induction accelerator and provides a test facility for demonstration of the high-average-power components and high-brightness sources used in such accelerators. The pulse drive for the accelerator is based on state-of-the-art magnetic pulse compressors with very high peak-power capability, repetition rates exceeding 1 kHz, and excellent reliability. 6 figs.

1498 **(UCRL—98964) The Lawrence Livermore National Laboratory (LLNL) multi-user Tandem Laboratory.** Davis, J.C. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 10p. (CONF-881151—18). NTIS, PC A03/MF A01. Order Number DE89001716/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

An FN tandem laboratory, cofounded by several Lawrence Livermore National Laboratory Divisions, Sandia Livermore, and the University of California Regents, is now operational at Livermore. The accelerator, formerly the University of Washington injector, has been upgraded with SF_6, Dowlish tubes, and a NEC pelletron charging system. A conventional duoplasmatron, a tritium source, and two Cs sputtering sources will be fielded on the accelerator. Pulsed beams will be available from two source positions. The laboratory has been designed to accommodate up to 19 experimental positions with excellent optics and working vacuum. The facility is unshielded with both accelerator and radiological systems under the control of a distributed microprocessor system. Research activities at the tandem include nuclear physics and astrophysics, materials science and characterization programs, and accelerator mass spectrometry for archaeology, biomedical, environmental and geoscience investigators. 3 refs., 1 fig.

1499 **(UCRL—98992) Distributed computer controls for accelerator systems.** Moore, T.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 11p. (CONF-881151—11). NTIS, PC A03/MF A01. Order Number DE89001130/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

A distributed control system has been designed and installed at the Lawrence Livermore National Laboratory Multi-user Tandem Facility using an extremely modular approach in hardware and software. The two tiered, geographically organized design allowed total system implementation with four months with a computer and instrumentation cost of approximately $100K. Since the system structure is modular, application to a variety of facilities is possible. Such a system allows rethinking and operational style of the facilities, making possible highly reproducible and unattended operation. The impact of industry standards, i.e., UNIX, CAMAC, and IEEE-802.3, and the use of a graphics-oriented controls software suite allowed the efficient implementation of the system. The definition, design, implementation, operation and total system performance will be discussed. 3 refs.

1500 **(UCRL—99727) Power conditioning for switched power linacs.** Kirbie, H.C. (Lawrence Livermore National Lab., CA (USA)). 5 Oct 1988. Contract W-7405-ENG-48. 17p. (CONF-8803146—3). NTIS, PC A03/MF A01. Order Number DE89001724/JAW.

From Workshop on pulse power techniques; Erice, Italy (5 Mar 1988).

This paper introduces the basic aspects of magnetic switching and magnetic pulse compression circuits, which can be used for charging a switched power linac (SPL) transmission line structure. The magnetic power conditioning scheme is illustrated by using the 1-km, 1-TeV injector in the Eloisatron Collider as a system example. Switched power linacs are viable candidates for the next generation of particle accelerators. In addition, a magnetically switched network shows promise as an efficient source of power for SPLs once energy recovery problems are solved. 20 refs., 4 figs.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 1496

1501 **(AD-A—195606/9/XAB) Theoretical modeling of accelerating arc plasmas. Final report, 31 July 1984-31 July 1987.** Huerta, M.A. (Miami Univ., Coral Gables, FL (USA)). 22 Apr 1988. 33p. NTIS, PC A03/MF A01.

The researchers present a calculation in a simplified geometry for the current distribution in the rails, taking into account the motion of the armature and the time variation of the current. Closed-form, asymptotic, results for the current density are obtained for arbitrary time-dependent electrical conductivity of the rails, and v is the speed of the armature. Because of eddy-current effects, the rail current may reverse in portions of the rails when the total current decreases. The current is used as a source of Joule heating to find the temperature distribution in the rails. The heat diffusivity is negligible and gives numerical results concerning melting.

1502 **(AD-A—196049/1/XAB) Accelerator development for the NRL (Naval Research Laboratory) free-electron-laser program. Final report, July 1981-April 1986.** Lucey, R.; Putnam, S. (Pulse Sciences, Inc., San Leandro, CA (USA)). 1 Jun 1988. 27p. (PSI-FR—121). NTIS, PC A03/MF A01.

Included in the report are descriptions of the final assembly and operation of the Linear Induction Accelerator(LIA), installation and testing of a new accelerating gap in the five-core stage of the accelerator to operate at 150 kV, and the moving of and modifications of the charging and firing controls for remote operation of the accelerator.

1503 **(ENEA-RT-TIB—87-49) Gain, absorption and saturation intensity measurements of an x-ray, preionized discharge pumped Xe-Cl laser.** Letardi, L.; Di Lazzaro, P.; Giordano, G.; Sabia, E.; Boffa, V.; Bollanti, S.; Hermsen, T.; Zheng, C.E. (ENEA, Frascati (Italy). Centro Ricerche Energia; Institute of Optics and fine Mechanichs, Shanghai, SH (China)). (ENEA, Rome (Italy)). 1988. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704433/JAW.

The small signal gain and absorption coefficients of a high uniformity, X-ray preionized Xe-Cl laser have been measured. Their time evolution and wavelength dependence have been simulated detected with high resolution. Two distinct estimates of the saturation intensity were obtained by means of a Rigrod-type analysis of the intracavity intensity and by using saturated gain measurements.

1504 **(JINR—9-87-838) Estimation of residual magnetic fields in secondary particle exit channel.** Kulikov, A.V.; Kuptsov, A.V.; Yaz'kov, V.V. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Moskovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704593/JAW.

A method of estimating magnetic fields in secondary particle exit channels is proposed. It is based on the analysis of oppositely charged particle pairs registered during experiment. The existence of magnetic fields causes changing of distance between particles at the channel exit. Knowing their coordinates and momenta one can estimate average value of magnetic field in the channel. For "Positronium" setup of IHEP proton synchrotron the observed particle displacements correspond to existing 0.3 Oe magnetic field. 3 refs.; 3 figs.; 2 tabs.

1505 **(JINR—9-87-896) Particle accumulation in the isochronous cyclotron.** Kozlov, S.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704594/JAW.

Results of numerical simulations of storing process of particles on the final radii of the isochronous cyclotron are presented. The accelerating dee system excited by coaxial three quarter wave short-circuit line which has zero of accelerating voltage on extraction radius was used. The obtained results demonstrate a possibility of storing more than hundred turns of a beam in a 15 mm radial interval at the extraction radius. Extraction of this stack with fast coils or by the rotating stripping foils produces an intense pulsed beam. This beam is suitable for a further injection into the storage-accelerating ring. 10 refs.; 3 figs.

1506 **(SAND—88-1297) Electron energy deposition necessary to form an anode plasma in Ta, Ti, and C for coaxial bremsstrahlung diodes.** Sanford, T.W.L.; Halbleib, J.A.; Poukey, J.W.; Pregenzer, A.L.; Pate, R.C.; Heath, C.E.; Mock, R.; Mastin, G.A.; Ghiglia, D.C.; Roemer, T.J. (Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). Oct 1988. Contract AC04-76DP00789. 67p. NTIS, PC A04/MF A01. Order Number DE89002111/JAW.

Measurements are made of surface doses necessary to initiate an anode plasma by electron bombardment of Ta, Ti, and C anodes for coaxial geometries characteristic of high-power electron-beam diodes. Measured lower and upper bounds of doses necessary to form an anode plasma are 54 +- 7 to 139 +- 16 J/g in Ta, 214 +- 23 to 294 +- 71 J/g in Ti, and 316 +- 33 to 494 +- 52 J/g in C. Within these bounds, probable values for the threshold are given under specific assumptions. The measurements are consistent with a thermal desorption model for plasma formation. 41 refs., 20 figs., 5 tabs.

1507 **(SAND—88-2522C) RLA [recirculating linear accelerator] injection and transport experiments.** Haworth, M.D.; Smith, D.L.; Mazarakis, M.G.; Poukey, J.W.; Leifeste, G.T.; Hasti, D.E.; Bennett, L.F.; Lucero, S.J. (Sandia National Labs., Albuquerque, NM (USA); Science Applications International Corp., Albuquerque, NM (USA); Diversus, Inc., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-8809149—14). NTIS, PC A02/MF A01. Order Number DE89001121/JAW.

From DARPA/SDIO services annual propagation review; Newport, RI, USA (12 Sep 1988).

The Sandia National Laboratories program to produce a light weight, compact, high voltage, high-current recirculating linear accelerator (RLA) uses a low-energy electron beam (LEEB) produced ion focus regime (IFR) plasma channel to electrostatically guide an intense relativistic electron beam (REB). The near-term goal is to inject a 1. 5-MV, 10-20 kA, 25-ns FWHM beam onto this IFR channel, which is in a racetrack configuration, and to accelerate the beam pulse using a 1.0-MV repeating waveform produced by a radial, dielectric cavity located in the racetrack. In this paper, we report on our recent experiments to optimize the transport of the beam from the isolated Blumlein (IB) injector onto a straight section of the racetrack IFR channel with no additional acceleration present. Three different schemes have been tried to properly match the beam produced by the injector onto the IFR channel: an electrostatic wire zone, a low- pressure classical IFR gas cell, and a moderate-pressure gas cell. The results of these experiments plus our future experimental plans will be discussed. 8 refs., 6 figs.

1508 **(SAND—88-2597C) BUCKSHOT, analysis and benchmarking.** Wagner, J.S.; Shokair, I.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 2p. (CONF-8809149—18). NTIS, PC A02/MF A01. Order Number DE89001446/JAW.

From DARPA/SDIO services annual propagation review; Newport, RI, USA (12 Sep 1988).

A short discussion on benchmarking of an electron beam simulation code is given. (LSP)

1509 **(SAND—88-2598C) High current beam conditioning experiments.** Frost, C.A.; Jojola, J.M.; Leifeste, G.T.; Poukey, J.W.; Freeman, J.R.; Adams, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-8809149—21). NTIS, PC A02/MF A01. Order Number DE89001669/JAW.

From DARPA/SDIO services annual propagation review; Newport, RI, USA (12 Sep 1988).

High current beam conditioning experiments are being conducted on the IBEX accelerator at SNLA with the goal of developing an optimum beam conditioning cell for installation on RADLAC II for 20-MeV, 40-kA hose growth experiments. The IBEX accelerator can provide 4-MeV beams at greater than 50 kA and has been operated with both immersed and non-immersed diodes for these studies. Substantial progress has been in both increasing the current which can be conditioned and understanding the physics of high current beam conditioning. Both radius tailoring and beam centering have been demonstrated for beam currents greater than 30 kA. Three general types of conditioning cells have been studied and these are: classical IFR for radius tailoring, laser IFR for beam centering, and a new type, the B/sub θ/ wire cell, that may achieve both goals simultaneously. Time- resolved measurements of the performance of these conditioning cells are discussed. 7 refs., 4 figs.

1510 **(SAND—88-2859C) Recent ion hose related experiments and revisions of the EPOCH hardware.** Kamin, G.W.; Shokair, I.R.; O'Brien, K.; Wagner, J.S.; Lipinski, R.J.; Armistead, D.J.; Hogeland, S.; Kiekel, P.D.; Molina, I.; Smith, J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-8809149—20). NTIS, PC A02/MF A01. Order Number DE89001671/JAW.

From DARPA/SDIO services annual propagation review; Newport, RI, USA (12 Sep 1988).

The EPOCH experiment at Sandia National Laboratories has recently addressed one of several possible methods for "detuning" the ion hose instability. An attempt at suppressing the ion hose growth rate by temporally modifying the global neutralization fraction by beam induced ionization will be reported. The lack of quantitative agreement between these tests and the code simulations is attributed to an uncertainty in initial conditions and a lack of reproducibility arising from non-uniform emission from the velvet cathode of the EPOCH diode. A revision of the experimental hardware is currently underway to remedy some of these problems. 3 refs., 5 figs.

1511 **(SLAC-PUB—4692) Depolarization due to beam-beam interaction in electron-positron linear colliders.** Yokoya, Kaoru; Chen, Pisin. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 7p. (CONF-880983—4). NTIS, PC A02/MF A01. Order Number DE89002070/JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

We investigate two major mechanisms which induce depolarization of electron beams during beam-beam interaction in linear colliders. These are the classical spin precession under the collective field of the oncoming beam, and the spin-flip effect from beamstrahlung. Analytic formulas are derived for estimating these depolarization effects. As examples, we estimate the depolarization in the Stanford Linear Collider (SLC) and a possible future TeV linear collider (TLC). The effects are found to be negligibly small for SLC and not very large for TLC. 7 refs., 1 fig.

1512 **(SLAC-PUB—4720) Beam determination of quadrupole misalignments and beam position monitor biases in the SLC linac.** Lavine, T.L.; Seeman, J.T.; Atwood, W.B.; Himel, T.M.; Petersen, A.; Adolphsen, C.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 3p. (CONF-881049—30). NTIS, PC A02/MF A01. Order Number DE89002393/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

Misalignments of magnetic quadrupoles and biases in beam position monitors (BPMs) in the Stanford Linear Collider (SLC) linac can lead to a situation in which the beam is off-center in the disk-loaded waveguide accelerator structure. The off-center beam produces wakefields which can limit SLC performance by causing unacceptably large emittance growth. We present a general method for determining quadrupole misalignments and BPM biases in the SLC linac by using beam trajectory measurements. The method utilizes both electron and positron beams on opposite rf cycles in the same linac lattice to determine simultaneously magnetic quadrupole misalignments and BPM biases. The two-beam trajectory data may be acquired without interrupting SLC colliding beam operations. 2 refs., 5 figs.

1513 **(SLAC-PUB—4722) The roles of frequency and aperture in linac accelerator design.** Farkas, Z.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 3p. (CONF-881049—29). NTIS, PC A02/MF A01. Order Number DE89002394/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

Expressions for accelerating structure parameters, including those that determine the peak and average power inputs required to attain a given gradient, are given as functions of aperture to wavelength ratio for a $2\pi/3$ mode disk-loaded guide. The value of the wavelength to aperture ratio varies over a large range, corresponding to group velocities that vary from nearly zero to nearly the speed of light. The parameters exhibit proper asymptotic behavior in both limits. These parameters are benchmark values to which parameters for other modes and for other structure shapes can be compared. For example, it will be shown that the increased peak surface field to accelerating field ratio due to increased aperture to wavelength ratio can be reduced by shaping the iris profile. Structure shapes are varied not only to show possible improvement of structure parameters, but also to improve ease of mechanical fabrication and temperature control. 4 refs., 8 figs., 1 tab.

1514 **(UCRL—21116) CHIPS [Channel Hydrodynamics Integrated with Pulse Simulation]: A phenomenological WIPS mode propagation code: Physical model.** Lee, E.; Masamitsu, J.; Melendez, R. (Lawrence Livermore National Lab., CA (USA); Pulse Sciences, Inc., Mountain View, CA (USA)). Jul 1988. Contract W-7405-ENG-48. 164p. NTIS, PC A08/MF A01. Order Number DE89001427/JAW.

The present code (named CHIPS for Channel Hydrodynamics Integrated with Pulse Simulation) was conceived from a desire to model the WIPS bolt with a 1-d code which resolved the head-to-tail variation of parameters within each pulse. That is, the independent variables of CHIPS are z and x and pulse number rather than just z and pulse number. Due to the long time separation between pulses, the time dependent details of channel formation are not resolved. Instead, a set of formulas connect channel parameters from one pulse to the next at every specified z position. A second important reduction of the description is that a pulse is considered to be in a state of dynamic equilibrium. This allows z steps to be used which are long compared with a betatron wavelength. These two basic approximations produce a code with which a useful run takes a few minutes on the CRAY 1 computer, and parameter surveys are therefore possible. The role of the present report is to lay out the physical model of CHIPS in its initial version (completed December 1987). There are three broad domains of the physical model, with varying degrees of novelty: Beam Dynamics and Electromagnetic Field, a standard 1-d treatment assuming dynamic equilibrium; Air Chemistry, a fairly detailed model of on-axis quantities based on EMPULSE III treatment; and Channel Hydrodynamics, new formulas relate energy deposition to expansion. It must be stated that CHIPS is an initial version of a WIPS train code, and various extensions, improvements and even corrections will be apparent to the user. The code has a modular structure with sufficient comments that these changes can be readily carried out.

1515 **Laser wakefield acceleration and relativistic optical guiding.** Sprangle, P.; Esarey, E.; Ting, A.; Joyce, G. (Plasma Theory Branch, Plasma Physics Division, Naval Research Laboratory, Washington, DC 20375-5000). *Applied Physics Letters;* **53**: No. 22, 2146-2148(28 Nov 1988).

An electron acceleration method is investigated which employs a short (tau/sub L/ $\sim 2\pi\omega\omega$/sup -1//sub p/ $\sim$1 ps), high-power (P$\geqq$10/sup 15/ W), single frequency laser pulse to generate large amplitude (E$\geqq$1 GeV/m) plasma waves (wakefields). At sufficiently high laser powers [P$\geqq$17(ω/ω/sub p/)^2 GW], relativistic optical guiding may be used to prevent the pulse from diffracting within the plasma.

1516 **Studies of a flexible heliac configuration.** Hender, T.C.; Cantrell, J.L.; Harris, J.H.; Carreras, B.A.; Lynch, V.E.; Lyon, J.F.; Fabregas, J.A.; Guasp, J.; Lopez-Fraguas, A. (Culham Lab., Abingdon, Oxon (GB)). *Fusion Technology;* **13**: No. 4, 521-535(May 1988).

A detailed study of the flexible Heliac configuration is presented. The remarkable flexibility of this device, which allows variation of the rotational transform, shear, and magnetic well depth over a relatively wide range, is described. Engineering considerations of error fields, finite cross-section conductors, and plasma-coil clearances are also discussed.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 1272, 1496, 1498, 1507, 1589, 2250, 2655

1517 (ACIESP—60-Vol.1, pp 6) **Main applications of accelerators. Reactor and irradiation sources. Cyclotrons.** Lucki, G. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1518 **(BNL—41181) Outgassing and desorption of the stainless steel beam tubes after different degassing treatments.** Hseuh, H.C.; Cui, Xiuhua. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 19p. (CONF-881002—14). NTIS, PC A03/MF A01. Order Number DE89001268/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Chemical cleaning, vacuum firing, glow discharge cleaning and insitu bakeout have become standard practice for lowering the outgassing rate and removing surface contaminants in the ultra high vacuum systems of particle accelerators and storage rings. This paper presents the work done with the thermal outgassing of several long stainless steel (304LN and 316L) beam chambers with areas of more than 1 x 10^4 cm^2. They were measured between 20{degree} C and 500{degree} C after vacuum firing, glow discharge cleaning or reactive gas (nitric oxide) cleaning. Outgassing rates of low 10^{-13} and low 10^{-14} Torr .l/s.cm^2 were achieved for H_2 and CO, respectively, with vacuum firing alone. The outgassing of H_2 in this temperature range is consistent with that due to bulk diffusion with an enthalpy of 9 +- 1 Kcal/mole. The photon stimulated desorption of the chamber surface after the above treatments were also studied by exposure to an intense photon beam at the National Synchrotron Light Source. The effectiveness and merits of reactive gas cleaning in removing the surface contaminants in large vacuum systems are compared to those of vacuum firing and glow discharge cleaning. 14 refs., 5 figs.

1519 **(BNL—41882) Accelerating structure with linear excitation.** Fischer, J.; Srinivasan-Rao, T. (Brookhaven National Lab., Upton, NY (USA)). Mar 1988. Contract AC02-76CH00016. 12p. (CONF-8803146—2). NTIS, PC A03/MF A01. Order Number DE89001610/JAW.

From Workshop on pulse power techniques; Erice, Italy (5 Mar 1988).

The switched power linac (SPL) structures require a ring-shaped laser beam pulse of uniform intensity to avoid transverse field components of the accelerating field at the center. In order to also utilize the reflection of the outgoing EM wave, the switching element has to be very close to the outer edge of the structure to ensure nearly synchronous superposition at the beam hole with the original inward going wave. It is sometimes easier to produce linear (flat) laser beams, e.g., from powerful excimer lasers which have beams of rectangular cross section. Such flat beams could be used to excite linear photocathode switches or be used to produce flat electron beam pulses in electron sources. In this paper, an accelerator structure is proposed which may be considered a variant of the SPL disk structure, but could be used with linear beams. The structure utilizes a double parabolic horn. 8 refs., 9 figs.

1520 **(DOE/ER/40374—7) Frequency-domain considerations in magnet sorting.** Ohnuma, S. (Houston Univ., TX (USA). Dept. of Physics). 1988. Contract FG05-87ER40374. 5p. (CONF-8804111—6). NTIS, PC A02/MF A01. Order Number DE89001574/JAW.

From 2. International Committee for Future Accelerators advanced beam dynamics workshop; Lugano, Switzerland (11 Apr 1988).

For large superconducting synchrotrons such as the Tevatron or the proposed SSC, the random normal sextupole component of dipoles is the most important factor in limiting their linear aperture. Since one selects the operating point in the tune diagram such that the third-integer resonances driven by particular harmonic components are not serious, the linear aperture cannot be enlarged by reducing these harmonic components alone. The magnet sorting scheme described in this note still depends on the harmonic description of the aperture-limiting effects but it tries to control a large number of harmonic components in the most troublesome regions. The scheme assumes that the sextupole component of each magnet is known and that, for each sorting group, there will be enough magnets to cover more than on betatron oscillation period. The "global" scheme is combined with the "local" sorting scheme such that the effectiveness of the scheme does not depend too strongly on a small change in tunes. An example is given to show that it is possible to achieve an order-of-magnitude reduction in the phase-space distortion ("smear") when some forty magnets are sorted as a group. 10 refs.

1521 **(GA-A—19453) Using S1032 in the scientific environment.** Miller, S.M. (General Atomics Co., San Diego, CA (USA)). Sep 1988. Contract AC03-84ER51044. 19p. (CONF-881191—1). NTIS, PC A03/MF A01. Order Number DE89001436/JAW.

From Annual system 1022/1032 users' conference; Cambridge, MA, USA (7 Nov 1988).

Large quantities of data are generated every day from the Fusion experiments conducted at General Atomics. This presentation will show how S1032 has been used in conjunction with DCL and FORTRAN to provide a means for selecting and using some of this data for plots and reports. Extensive use is made of S1032 tools and customized forms. 17 figs.

1522 **(ITEF—199(1987)) Influence of diaphragms on expanding laser plasma.** Erema, Yu.N.; Latyshev, S.V.; Petrov, V.V.; Rudskoj, I.V.; Shumshurov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704580/JAW.

From experimental and theoretical data it results, that expanding laser plasma diaphragming leads to weakening of ion flux density within expansion distant range. Flux density is weakened more essentially for low-energy ions. Weakening increases with diaphragm diameter reduction. Rather big diaphragms do not influence on laser plasma central part expansion. 7 refs.; 7 figs.

1523 **(JINR—9-88-7) Study of ion source with a hollow cathode and beam axial extraction.** Vasil'ev, N.V.; Glazov, A.A.; Novikov, D.L.; Semenov, M.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1988. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704595/JAW.

The results of investigation of pulse Penning type ion source with a cold hollow cathode intended for using in direct action accelerators having a short pulse and a high repetition are presented. The pulse supply system and ion parameter measuring systems are described. Stable discharge arc of about 14 A current takes place for 50-10000 Hz repetition rate. The extraction current pulse upto 400 mA has been obtained. 4 refs.; 5 figs.

1524 **(JINR-R—9-88-20) /sup 4/He/sup 1+/ ion beam transport in the U-200 cyclotron axial injection system.** Vinogradov, Yu.B.; Gikal, B.N.; Gul'bekyan, G.G.; Efremov, A.A.; Kalchev, D.I.; Kutner, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1988. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704649/JAW.

A system fo axial injection of ions has been constructed on the U-200 cyclotron. It was tested in the /sup 4/He/sup 1+/ ion beam obtained from the high-frequency source. Efficiency of beam transport from the ion source to the extraction radius was 8%. The effect of transport element instabilities, of vacuum in ion channel and of other accelerator parameters on the beam transport efficiency has been investigated. 12 refs.; 12 figs.; 3 tabs.

1525 **(JINR-R—10-87-871) Organization of superconducting synchrotron cycle fault-tolerant control based on the MERA-60 (Electronika-60) microcomputer.** Bazyleva, N.P.; Efimov, L.G.; Pasevich, K.; Susova, G.M.; Ehnkhbold, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704650/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

The organization of work a cycle control subsystem of the SPIN model superconducting accelerator in the mode of cryogenic synchrotron testing is presented. This subsystem is based on a MERA-60 (electronica-60) microcomputer. Hardware and software of the system based on the MERA-60 microcomputer are described. This complex provides the remote cyclic control of industrial power supplies of the synchrotron magnet system in accordance with amplitude - time parameters given by the operator, as well as the synchronization of accelerator units and control of its element efficiency. The methods for providing the reliability of multiprogram (multimode) accelerator cycle control based on using a wide-range timer "Time Guard", means for remote control of microcomputer supply and its program restart, as well as unique organization of program exchange operative memory of microcomputer and standard disk memory device are considered. The given methods permitted to avoid accidents on a superconducting accelerator caused by automation system, provide parameter registering and flexible readjusting of synchrotron mode of operation, as well as minimal operator action at subsystem start-up and its current operation. 7 refs.; 7 figs.

1526 **(KEK—88-1) CASIM calculations and angular dependent parameter β in the Moyer model.** Yamaguchi, Chiri. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Apr 1988. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755233/JAW.

The dose equivalent on the shield surface has been calculated using both the Moyer model and the Monte Carlo code CASIM. Calculations with various values of the angular distribution parameter β in the Moyer model show that $\beta = 7.0 +- 0.5$ would meet the CASIM results at most, especially regarding locations at which the values of the maximum dose equivalent occur.

1527 **(LBL—25803) Multilayer mirrors as power filters in insertion device beamlines.** Kortright, J.B.; DiGennaro, R.S. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 20p. (CONF-8808141—2). NTIS, PC A03/MF A01. Order Number DE89000566/JAW.

From 3. international conference on synchrotron radiation instruments; Tokyo, Japan (29 Aug 1988).

The power-filtering capabilities of multilayer band-pass x-ray mirrors relative to total reflection low-pass mirrors is presented. Results are based on calculations assuming proposed wiggler sources on the upcoming generation of low energy (1.5 GeV) and high energy (7.0 GeV) synchrotron radiation sources. Results show that multilayers out-perform total reflection mirrors in terms of reduction in reflected power by roughly an order of magnitude, with relatively small increases in total absorbed power and power density over total reflection mirrors, and with comparable reflected flux values. Various aspects of this potential application of multilayer x-ray optics are discussed. 13 refs., 3 figs., 1 tab.

1528 **(RAL—86-014) Cooling of the ISIS target.** Curtis, W.J. (Rutherford Appleton Lab., Chilton (UK)). Feb 1986. 168p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780105/JAW.

The paper describes the methods used to analyse and predict cooling of the uranium target of the ISIS facility at the Rutherford Appleton Laboratory by means of a combination of computer models (suing the PHOENICS finite difference package) and practical tests.

1529 **(SAND—88-2616C) High brightness injector studies on IBEX.** Frost, C.A.; Leifeste, G.T.; Poukey, J.W.; Hasti, D.E.; Jojola, J.M.; Jones, E.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-8809149—23). NTIS, PC A02/MF A01. Order Number DE89001822/JAW.

From DARPA/SDIO services annual propagation review; Newport, RI, USA (12 Sep 1988).

RADLAC II is a high current linear induction accelerator for electrons. The beam is produced in a field-immersed foilless diode injector. We report the first time-resolved characterization of similar high-brightness immersed diode source using a time-gated, 2-D x-ray imaging technique. The experiments were performed on the 4-MeV IBEX accelerator and produced currents exceeding 40 kA in a 6-mm radius, thin annular beam with a measured thermal transverse velocity v/sub {perpendicular}/ = β/sub {perpendicular}/c {approximately} 0.1c. For currents of 30 kA, even brighter beams with β/sub {perpendicular}/ = 0.07 were obtained. In all cases, the measured parameters were consistent with 2-D PIC simulations. The experimental results will be discussed and compared to theory and simulations. 7 refs., 5 figs., 1 tab.

1530 **(SLAC-PUB—4703) The rf phase system of the SLC.** Jobe, R.K.; Clendenin, J.E.; Schwarz, H.D.; Seeman, J.T.; Sheppard, J.C.; Stiening, R.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 4p. (CONF-881049—32). NTIS, PC A02/MF A01. Order Number DE89002388/JAW.

From Linear accelerator conference; Williamsburg, VA, USA (3 Oct 1988).

The phases of the rf throughout the SLC accelerator complex play an important part not only in the energy and energy spread of the beams at the end of the linac, but also in the production process of both electrons and positrons. Proper machine operation requires that certain phase relationships be maintained between the rf systems of the electron source, the electron and positron damping rings, the linac, and the positron source. This paper presents an overview of the interplay of the various rf phases throughout the SLC accelerator complex as well as describing various hardware and software inter-connections which have been made to facilitate control of the system as a whole. In addition, a description is given of rf phase monitoring required for system control. Operational experience and future plans are also discussed. 6 refs., 4 figs.

1531 **(UCID—21525) Design of a superconducting wiggler system.** Shen, S.S.; Miller, J.R.; Heim, J.R.; Slack, D.S. (Lawrence Livermore National Lab., CA (USA)). 5 Oct 1988. Contract W-7405-ENG-48. 15p. NTIS, PC A03/MF A01. Order Number DE89001856/JAW.

We present a wiggler system based on currently available superconducting technology. The system is designed to provide maximum central field of 4.4 tesla with a specified period length of 160 mm and a gap of 40 mm, while meeting the field quality requirements along all axes. Also included are preliminary cost estimates and a survey of world-wide R&D efforts on superconducting wiggler systems. 12 refs., 6 figs., 3 tabs.

1532 **(UCRL—99308-Rev.1) PEGASYS: A proposed internal target-spectrometer facility for the PEP storage ring.** Van Bibber, K. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 18p. (CONF-881151—20). NTIS, PC A03/MF A01. Order Number DE89001924/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

A proposal for an internal gas-jet target and forward spectrometer for the PEP storage ring is described. The beam structure, allowable luminosity (L=10^{33} cm/sup {minus}2/s/sup {minus}1/ for H_2, D_2 decreasing as Z/sup {minus}1.75/ for nuclear targets) and energy (E/sub e/$\leq$ 15 GeV) make the ring ideal for multiparticle coincidence studies in the scaling regime, and where perturbative QCD may be an apt description of some exclusive and semi-inclusive reactions. 17 refs., 5 figs.

1533 **Resonant power supplies for a rapid-cycling accelerator.** Karady, G.; Thiessen, H.A.; Schneider, E.J. (Arizona State Univ., Tempe, AZ (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 5, 1092-1098(Oct 1988).

A resonant power supply has been proposed as an efficient power supply for a future 60 GeV, kaon-producing accelerator. This report presents a detailed analysis of the circuit operation. Based on these analyses each component is designed, one-line diagram is developed, component requirements are determined and a detailed cost estimate is prepared. The major components of the system are: the magnet power supply, high-voltage by-pass thyristor switch, with 10-kA repetitive interruption capability, capacitor banks, capacitor bank thyristor switch, and an energy make-up device. The most important components are the bypass thyristor switch and the energy injection device. The bypass thyristor switch is designed to turn on and interrupt 10-kA dc current with a recovery voltage of 20kV and repetition frequency of 3 Hz. The switch consists of a large array of series- and parallel-connected thyristors and gate turn-off (GTO) devices. The make-up energy device is designed to replace the circuit energy losses.

4304 Storage Rings

1534 **(DOE/ER/40374—6) The second advanced ICFA [International Committee for Future Accelerators] beam dynamics workshop, Lugano, Switzerland, April 11-16, 1988: Foreign trip report.** Ohnuma, Shoroku. (Houston Univ., TX (USA). Dept. of Physics). 23 Apr 1988. Contract FG05-87ER40374. 22p. (CONF-8804111—Summ.). NTIS, PC A03/MF A01. Order Number DE89001599/JAW.

From 2. International Committee for Future Accelerators advanced beam dynamics workshop; Lugano, Switzerland (11 Apr 1988).

This paper summarizes the trip made by Shoroku Ohnuma to the Second Advanced ICFA Beam Dynamics Workshop in Switzerland. Discussed are the experimental and theoretical studies conducted on aperture- related limitations of storage ring performance. Lepton and hadron storage ring machines are mainly mentioned. (LSP)

1535 **(LA-UR—88-3414) Implementation of a distributed computer control system at the Los Alamos Proton Storage Ring.** Poore, R.V.; Byrnes, L.L.; Harrington, M.P.; Stuewe, R.B.; Westervelt, R.T. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-8809176—1). NTIS, PC A02/MF A01. Order Number DE89002131/JAW.

From 8. IFAC workshop on distributed computer control systems; Vitznau, Switzerland (13 Sep 1988).

A distributed computer control system is being implemented at the Los Alamos Proton Storage Ring using DEC MicroVAX computers with a distributed database. The first prototype system is now in place and has been running during the last storage ring running period. This paper describes the implementation, initial tests, and future plans for the system. 3 refs., 6 figs.

44 INSTRUMENTATION

REFER ALSO TO CITATION(S) 1248

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 305, 1345, 1346, 1348, 1349, 1352, 1353, 1387, 1388, 1453, 1454, 1532, 1688, 2008, 2056, 2130, 2139, 2141, 2160, 2161, 2319, 2420

1536 (ACIESP—60-Vol.1, pp 131) **Balloon-borne experiments to study hard X-rays and gamma-rays from SN 1987 A.** Nishimura, J.; Yajima, N.; Yamagami, T. and others. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1537 (ACIESP—60-Vol.1, pp 145) **Gamma-ray observations of supernovae SN 1987 A.** Souza, C.A.W.; Neri, J.A.C.F.; Jayanthi, U.B. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1538 (ACIESP—60-Vol.1, pp 145) **Cherenkov telescope cluster for very high energy gamma ray observations (COTO-GEMA).** Neri, J.A.C.F.; Jayanthi, U.B.; Villela, T.; Souza, C.A.W. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1539 **(AD-A—196288/5/XAB) Techniques in thin-film fabrication. Master's thesis.** Thompson, S.D. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1988. 90p. (AFIT/CI/NR—88-88). NTIS, PC A05/MF A01.

An improved method for preparing thin films for the plastic scintillator NE 102A is described. Detailed step-by-step instructions are given, beginning with preparation of the plastic solutions and ending with final mounting and storage of the films. The procedure typically yields one-lamination films of 45 ug/cm^2 thickness. Crosslinking in NE 102A scintillator solutions was induced with ^{60}Co gamma rays to study the effect on physical strength of subsequent thin films. The polyvinyltoluene matrix was found to undergo crosslinking with essentially no chain scission, and a gelling dose of 5.42 Mrad was determined experimentally; the G(crosslink) = 0.74. Thin films were made from NE 102A solutions which absorbed 0, 1.81, and 3.62 Mrad each. The response characteristics of each film were determined using a Cf-252 source. In general, the films from the irradiated solutions showed no evidence of diminished light output or inhomogeneity. However, films formed from the crosslinked solutions were unequivocably stronger, with strength increasing with dose.

1540 **(BNL—41788) Waveform digitizing at 500 MHz.** Atiya, M.; Ito, M.; Haggerty, J.; Ng, C.; Sippach, F.W. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 18p. (CONF-8806235—2). NTIS, PC A03/MF A01. Order Number DE89001605/JAW.

From International conference on advanced technology and particle physics; Como, Italy (12 Jun 1988).

Experiment E787 at Brookhaven National Laboratory is designed to study the decay $K^+ \rightarrow \pi^+ \nu\{bar\ \{nu\}\}$ to a sensitivity of 2 {times} 10^{-10}. To achieve acceptable muon rejection it is necessary to couple traditional methods (range/energy/momentum correlation) with observation of the ($\pi^+ \rightarrow \mu^+ \nu$, $\mu^+ \rightarrow e^+ \nu\{bar\ \{nu\}\}$) decay sequence in scintillator. We report on the design and construction of 200 channels of relatively low cost solid state waveform digitizers. The distinguishing features are: 8 bits dynamic range, 500 MHz sampling, zero suppression on the fly, deep memory (up to .5 msec), and fast readout time (100 μsec for the entire system). We report on data obtained during the February-May 1988 run showing performance of the system for the observation of the above decay. 8 figs.

1541 (DOE/ER/60631—1, pp 63-71) **Multi-element proportional counter for radiation protection measurements.** Kliauga, P.; Rossi, H.H.; Johnson, G. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

This article discusses design modifications of a multi-element proportional counter. The original counter exhibited poor resolution, as measured by the width of the event-size spectrum for low-energy photons. It was also suspected that the field inside each volume was not sufficiently symmetric. Results of the modifications showed that a dramatic improvement in resolution could be obtained in the chamber with tissue-equivalent septa if their potentials were adjusted to obtain optimal resolution. The full width at half maximum then approached, although it did not equal, that of a standard spherical counter.

1542 (DOE/ER/60631—1. pp 72-75) **Secondary emission scintillation counter for microdosimetry at the nanometer level.** Goldhagen, P. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

The secondary emission scintillation (SES) counter is a device designed to count the positive ions of charged-particle tracks in gas volumes simulating sites in tissue with diameters of the order of 1 nanometer. A diagram of the current prototype SES counter is shown. A weak electric field in the cylindrical collection region of the device drifts ions from a track to a small region (~ 1-mm deep) of high electric field where they are accelerated by several kilovolts onto a dynode, producing secondary electrons. The secondary electrons are then accelerated onto a plastic scintillator, and the resulting light is detected by a photomultiplier. The passage of a charged particle is established by a solid state detector, which triggers electronics detecting coincidences and measuring the timing and amplitude of pulses from the photomultiplier. In the prototype, the beam of charged particles comes from an internal collimated alpha-particle source. The SES counter is filled with gas at a uniform pressure of about 0.05 torr or less. At this pressure, 1 cm of (nitrogen) gas in the counter is equivalent to 0.8 nm at unit density, and potentials of several kilovolts can be maintained in the accelerating region without producing electrical breakdown in the gas because most of the ions cross the region without striking a gas molecule.

1543 (DOE/ER/60631—1, pp 80-82) **Variance-covariance measurements of anti y/sub D/ for 5.7-MeV neutrons using wall-less spherical detectors.** Marino, S.A.; Kliauga, P.; Goldhagen, P. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

Initial results of measurements of anti y/sub D/ for 5.7-MeV neutrons in wall-less spherical detectors, obtained using the variance-covariance (VC) technique, were presented in last year's Annual Report. During the past year, the electrometers have been calibrated and found to be within less than 1% of their nominal value. The VC data have been corrected for electrometer offsets and calibrations. In addition, some measurements were recalculated, excluding runs in which the relative covariance was more than 2.6 times greater than the relative variance (due to large changes in beam intensity from tuning the accelerator during a run). Pulse-height measurements of y were made in the usual manner using the same detectors, and the angle and distance from the target were the same as were used for the VC measurements. Propane-based, tissue-equivalent (TE) gas was used instead of the methane-based TE gas used when the detectors functioned as ionization chambers for the VC method. Calibrations were made using 1.5 keV Al K/sub α/ X rays. Results of the VC and pulse-height measurements are given. The new anti y/sub D/ values for the VC technique are about 7% lower than the previous values, while the pulse-height measurement values are about 25% lower than the corresponding previous values. Lower values of anti y/sub D/ are expected, due to the use of a wall-less chamber, the change from a long, thin cylinder to a sphere, and the change in irradiation angle causing the γ-ray dose fraction to more than double.

1544 **(DP-MS—88-193) Speed of response for several neutron detectors including a new hafnium detector.** Randolph, H.W.; Sessions, H.T. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 21p. (CONF-8810210—1). NTIS, PC A03/MF A01. Order Number DE89001652/JAW.

From National Organization of Test, Research, and Training Reactors meeting; New Port, OR, USA (7 Oct 1988).

Response speed was determined for several neutron detectors by exposing them to short duration flux in a Godiva reactor. The fastest response was obtained from a new hafnium detector which responded 2% faster than the gamma photodiode used to monitor the reactor. 15 refs.

1545 **(IAEA-TECDOC—363/S) Selected topics in nuclear electronics.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1988. 342p. (In Spanish). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88704481/JAW.

Translated from English, Report no. IAEA-TECDOC-363.

The IAEA training courses in the field of nuclear electronics heavily rely upon practical work in the laboratory. Accordingly, the IAEA has produced and published the Nuclear Electronics Laboratory Manual (TECDOC 309) where the experience on organizing the efficient practical training in nuclear electronics was compiled. The present publication is focused on the theoretical understanding of basic electronic circuits and is of particular importance to the attendees of the IAEA training course. The present publication does not copy any available book on nuclear electronics and instrumentation. On purpose, it does not describe the elementary electronics circuits as applied in nuclear instruments; they can be found in books. It starts the nuclear electronics study on the instruments level, continues to describe the technology and circuitries on the board level, and only in some exceptional cases investigates the circuits on the components level. It is believed that such an approach better reflects the advanced status of nuclear electronics and the philosophy of the modern design of nuclear instruments. For illustration, and wherever it appeared useful, some commercial instruments are described and analyzed. Figs and tabs.

1546 **(IAEA-TECDOC—469) Neutron physics and nuclear data measurements with accelerators and research reactors. Lectures presented at the interregional training course held in Riga and Leningrad, USSR, 18-30 May 1987.** (International Atomic Energy Agency, Vienna (Austria); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). Aug 1988. 173p. (CONF-8705343—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW.

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

The report contains a collection of lectures devoted to the latest theoretical and experimental developments in the field of fast neutron physics and nuclear data measurements. The possibilities offered by particle accelerators and research reactors for research and technological applications in these fields are pointed out. Refs, figs and tabs.

1547 (IAEA-TECDOC—469, pp 142-168) **Principles, techniques and applications of solid state nuclear track detectors.** Guo Shilun. (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

This lecture describes the basic principles, the commonly used techniques and the successful and novel applications of solid state nuclear track detectors as if the listeners are those who are looking for new trends in rapid developing fields and are anxious to acquire the necessary information to step into modern research fronts. (author). 70 refs, 22 figs, 3 tabs.

1548 (IAEA-TECDOC—469, pp 168-173) **Solid state nuclear track detectors for registration of nuclear reaction products.** Kocherov, N.P.; Shigaev, O.E. (Radievyj Inst., Leningrad (USSR)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

Practical aspects of exposing, etching and scanning of solid state detectors are reviewed. Detector response functions and particle identification methodologies are discussed. Applications for personal neutron dosimetry, fission studies, radon monitoring and behaviour in high background radiation conditions are outlined. (author). 10 refs, 6 figs, 1 tab.

1549 (IAEA-TECDOC—469, pp 112-118) **Thermoluminescent neutron dosimetry.** Gotlib, V.I. (Riga Medical Inst. (USSR)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

The application of TL dosimeters for personal dosimetry in broad energy range neutron fields is discussed. The principles of neutron registration and different configurations of albedo neutron dosimeters using LiF as a registration medium are given in detail. (author). 5 refs, 7 figs.

1550 (IAEA-TECDOC—469, pp 118-128) **Dosimetry of ionizing radiation on the basis of natural materials. A review.** Tale, I.A. (Latvijskij Gosudarstvennyj Univ., Riga. (USSR). Nauchno-Issledovatel'skij Inst. Fiziki Tverdogo Tela). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

Physical effects which are used in solid state dosimetry, such as radiophotoluminescence, exoelectron emission, scintillation and ESR are briefly described. The practical problems encountered in such dose measurements and calibrations are described. (author). 17 refs, 7 figs, 3 tabs.

1551 (IAEA-TECDOC—469, pp 101-108) **Measurement of activation integrals in neutron fields.** Troshin, V.S. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

The most widespread methods of activation integral measurements by β and γ counting conversion electron detection, β-γ coincidences are discussed in detail. Possible sources of errors are underlined and the necessary correction factors are calculated. (author). 2 refs, 1 tab.

1552 (IAEA-TECDOC—469, pp 89-94) **Development of the time correlated associated particle method for absolute measurements of reaction cross-sections.** Shpakov, V.I.; Kuzmin, V.N. (Radievyj Inst., Leningrad (USSR)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

A new modification of the TCAP method which enables to avoid some drawbacks of the former techniques has been developed at the Khlopin Radium Institute. The magnetic analysis of the accompanying particles was first introduced. The magnetic separation excluded completely background components due to protons and tritons from the D(d,p)/sup 3/H associated reaction and reduced the background of scattered beam deuterons by a factor of 2-3 orders of magnitude. The modified technique was used to perform neutron induced fission cross section measurements. (author) 11 refs, 6 figs.

1553 **(IFVE-OEF—87-198) Specialized processor for data read-out and buffering in the GAMS-2000 data acquisition system.** Donskov, S.V.; Inyakin, A.V.; Samojlenko, V.D.; Sugonyaev, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704489/JAW.

A programmable processor for data read-out and buffering in CAMAC system is described. The processor uses FISHER system philosophy for access to CAMAC system. All programming and control of the processor are accomplished by computer

through CAMAC system. In an autonomous mode the processor carries out all data read-out and buffering during the accelerator cycle with further data transfer to the computer. The processor within GAMS-200 data acquisition system allows one to reduce the read-out time for 1 event by an order of magnitude and to increase 3 times throughout in data taking mode. 6 refs.; 5 figs.; 1 tab.

1554 **(IFVE-OEF—88-27) Coordinate measurement of electromagnetic shower core by hodoscope using HPM with active lead glass converter.** Belousov, V.I.; Blik, A.M.; Vasil'chenko, V.G. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704490/JAW.

Submitted to the journal Instrum. Exp. Tech. .

A hodoscope made of two layers of scintillation fibers 3 mm in diameter and 1 m long has been used to measure the transverse position of electromagnetic shower maximum. The resolution is 2.5 mm with the convereter thickness being 3.4 rad. units for 5 GeV energy positrons. The counter parameters of the active 85x85x1000 mm converter made of lead glass are presented. 6 refs.; 6 figs.

1555 **(INIS-BR—1282) Didactic unity of Geiger-Mueller tube (Development of a prototype).** Xavier, W.F. (Santa Catarina Univ., Florianopolis (Brazil)). 1983. 39p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704525/JAW.

The design of radiation counter for Geiger-Mueller regions is described. (M.C.K.).

1556 **(INT—175/I) Gas amplification factor in Kr + iso-pentane filled proportional counters.** Kowalski, T.Z. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1983. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704568/JAW.

Received in 1986.

Measurements of gas amplification in a proportional counters with Kr/iso-pentane mixture were performed at pressures ranging from 160 to 970 hPa. A new formula for gas amplification in a proportional counters was derived. A good agreement between the formula and experimental data was found over the range of variables studied. 16 refs., 4 figs., 1 tab.

1557 **(INT—176/I) Gas multiplication process in Kr/iso-pentane filled proportional counters.** Kowalski, T.Z. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1983. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704569/JAW.

Received in 1986.

The gas amplification factor A has been measured for Kr/iso-pentane mixtures (over the range 1<A<5x10/sup 4/) to verify the validity of the formulae of Rose and Korff, Curran and Craggs, Diethorn, Williams and Sara, Khristov and Zastawny. Only the expressions of Zastawny and Diethorn can be fitted over a limited range of A. 17 refs., 8 figs.

1558 **(INT—177/E) Wandering probe with digital data recording for the leak detection in the gas mains.** Korbel, K.; Lacki, E. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1983. 24p. (In Polish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704570/JAW.

Received in 1986.

The technical description of a subsequent version of the wandering probe, constructed in the framework of the development programme of methods and instrumentation for control of the leak in long distance gas-mains is presented. In the electronic circuitry of the probe a digital data recording was applied. This concerns in particular the leak distance from the pipe inlet as well as the relative leak intensity. 5 refs., 7 figs.

1559 **(INT—179/E) Noise and optimum filtering in spectrometers with semiconductor detectors operating at elevated temperature.** Dabrowski, W.; Korbel, K. (Institute of Physics and Nuclear Techniques, Krakow (Poland)). 1983. 21p. (In Polish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704571/JAW.

Received in 1986.

The importance of the excess noise in the semiconductor detectors operating at the elevated temperature is discussed. Under the assumption of a conventional CR-RC type filtration the variancy of the noise output is determined. The new term "second noise-corner time constant" was proposed. The expression for relative signal-to-noise ratio as the dependence on the noise as well as circuits time constants was derived. It was also presented in a graphical form. 12 refs., 6 figs.

1560 **(ITEF—147(1987)) Determination of charged particle track parameters in the ITEP 6-meter spectrometer.** Bolonkin, B.V.; Miller, V.V.; Nozdrachev, V.N.; Sutormin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704575/JAW.

The main parameters of magnetic 6-meter spectrometer, set at second particle beams of IHEP proton synchrotron, are considered. Determination algorithm of charged particle track parameters in spectrometer magnetic field is described. Spectrometer track detector is placed in 150x80 cm cross section electromagnet gap. Field induction nominal value in the gap centre is 1.9 T. Detector consists of 64 spark chambers with electrodynamic technique of information reading. A traditional method, based on numerical solution of two second-order differential equations system for charged particle trajectory in magnetic field and usage of least squares method when evaluating parameters and their errors, is used to determine particle track parameters. A new feature of the algorithm used is the introduction of supplementary parameter - spark cross driftage in crossing electric and magnetic fields. This new parameter characterizes track origination time in spectrometer relative to the start-up signal and is used to determine tracks unrelated to the event. The algorithm described is realized in computer codes for PDP-15, BESM-6 and ES 1060 computers. By their means ~300 thousand of events have been processed. The data obtained give evidence of conducting calculations satisfactory accuracy. 10 refs.; 16 figs.

1561 **(JINR—13-87-846) CAMAC controlled coincidence circuits.** Grebenyuk, V.M.; Kozhevnikov, Yu.A.; Selikov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704596/JAW.

The CAMAC coincidence circuits with control of a resolving time (0-16 ns) and input's delays (0-2 ns) with 60 ps pitch are described. Each unit containing one 8-input or two 4-input coincidence circuits. The 100 ps time resolution and 50 MHs internal performance is obtained. 6 refs.; 4 figs.; 1 tab.

1562 **(JINR—13-88-35) Nanosecond pulse high voltage generator with the FM-100-15UZ capacitors for a streamer chamber.** Aksinenko, V.D.; Dement'ev, E.A.; Kaminskij, N.I.; Matyushin, V.T.; Matyushin, A.T.; Ryakhovskij, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704597/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

The nanosecond pulse high voltage generator for supplying the JINR two-meter streamer chamber is described. The chamber parameters are: output pulse amplitude-500 kV, amplitude instability ≦ 1%, pulse duration - 12 ns (FWHM), delay time ≦ 300 ns, delay instability - (1.5-1.8)%. The pulse charge of generator forming line is performed from the Arkadiev-Marx generator with bipolar charging capacitors of the FM-100-15Uz type. The design of the Arkadiev-Marx generator is described, and its electric parameters

are given. up to date the generator in operating regime of the streamer chamber has provided about 235 thousand operations, among them 155 thousand operations (about 900 hours without repair) together with the streamer chamber during working expositions on the synchrophasotron. 6 refs.; 4 figs.

1563 **(JINR-R—10-87-887) Parallel interface of the Pravets-16 personal computer and its application for communication with ES-1010 computer in ALPHA-3C spectrometer automation system.** Zaporozhets, S.A.; Chernykh, E.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704651/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

Parallel interface for connection of Pravets-16 personal computer (PC) with other devices is developed. Its application for link with ES-1010 computer permits to transmit data with 20 KByte/rate to a few kilometer distances. Up to 4 Pravets-16 PC can be connected with ES-1010 via VT-50 interface. Connection protocol is supported by the ES-1010 computer standard software. 5 refs.; 4 figs.

1564 **(JINR-R—10-87-895) Filtering program of data scanning in the RISK spectrometer by means of JINR spiral reader.** Kalmykova, L.P.; Kotov, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704653/JAW.

The filtering program designed for initial scanning of the data obtained through digitizing by means of JINR spiral reader of the events of the experiment on the study of hadronic stream production of particles with a large transverse momentum (P) is described. This experiment has been fulfilled by means of RISK spectrometer based on a 5 meter streamer chamber. Specific features of filtering algorithms and their implementation on the program are discussed. The track following procedure is suggested for large deviations of sweep origin from event vetrtex. The program main characteristics and results of its work exploitation are presented. 9 refs.; 3 figs.; 3 tabs.

1565 **(JINR-R—10-88-42) FASTBUS 16-channel 8-bit analog-to-digital converter.** Parfenov, A.N.; Pilyar, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704655/JAW.

Submitted to the journal Prib. Tekh. Ehksp. .

A FASTBUS 16-channel 8-bit analog-to-digital converter is described. The module is made on the basis of an ultrafast integrated analog-to-digital converter (flash ADC K1107PV3). The range of the measured analog signals is +-2 V. An analog signal is converted to the digital code lineraly. Information from the ADC is read out via a FASTBUS dataway from two channels simultaneously during ~ 40 ns. The 16-channel ADC is used in the system for measuring the characteristics from the scintillation hodoscopes of the spectrometer SPHERE. 9 refs.; 5 figs.

1566 **(LA—11407-MS) A precision half-wave rectifier.** Kapustinsky, J.S.; Lillberg, J.W.; Boissevain, J.G. (Los Alamos National Lab., NM (USA)). Sep 1988. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01. Order Number DE89002091/JAW.

The paper describes an upgrade to the drift chamber readout electronics associated with the P-2 external spectrometer of the NA34/HELIOS experiment at the CERN Super Proton Synchrotron. The group determined in a recent test run the need to include flash- encoding ADCs along with the existing peak-sensing ADCs in their drift chamber readout. This upgrade enables them to distinguish events that are closely spaced in time and would otherwise go undetected. The upgrade required interface electronics capable of rectifying a bipolar input signal and providing a negative unipolar output. The circuit was to have a linear response and could not contribute adversely to the overall amplitude resolution of the system. We report on the circuit we designed to fulfill these requirements and on the initial results of installing and testing the units at CERN. 1 ref., 4 figs.

1567 **(LA-UR—88-3064) A comparison of germanium and copper analyzers for pulsed-source crystal-analyzer spectrometers.** Yethiraj, M.; Robinson, R.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 11p. (CONF-8810182—2). NTIS, PC A03/MF A01. Order Number DE89000352/JAW.

From International collaboration on advanced neutron sources; Los Alamos, NM, USA (3 Oct 1988).

We describe the new copper "organ-pipe" analyzer installed on the Los Alamos Constant-Q Spectrometer and compare its performance with the previous germanium analyzer. In addition, we discuss the implications of our experience for pulsed-source crystal-analyzer spectrometers in general. 7 refs., 4 figs.

1568 **(LA-UR—88-3099) On the kinematics and resolution of spectrometers for neutron Brillouin scattering.** Robinson, R.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 21p. (CONF-8810182—1). NTIS, PC A03/MF A01. Order Number DE89000349/JAW.

From International collaboration on advanced neutron sources; Los Alamos, NM, USA (3 Oct 1988).

Neutron Brillouin scattering involves measurement of excitations at smaller Q values than in currently customary. We outline the kinematic constraints on scattering angle and incident energy for excitations with both linear dispersion (sound waves) and parabolic dispersion (ferromagnetic spin waves), and discuss the resolution characteristics of the chopper spectrometer proposed for LANSCE which should be suitable for such studies. In particular, we demonstrate that longitudinal resolution focusing can be exploited both in neutron energy gain and in neutron energy loss. 13 refs., 8 figs., 1 tab.

1569 **(N—88-27120) Study of comet nucleus gamma-ray spectrometer penetration system.** Adams, G.L.; Amundsen, R.J.; Beardsley, R.W.; Cash, R.H.; Clark, B.C.; Knight, T.C.D.; Martin, J.P.; Monti, P.; Outteridge, D.A.; Plaster, W.D. (Martin Marietta Aerospace, Denver, CO (USA)). Mar 1986. 244p. (NASA-CR—177393; NAS—1.26:177393). NTIS, PC A11/MF A01.

A penetrator system has been suggested as an approach for making in situ measurements of the composition and physical properties of the nucleus of a comet. This study has examined in detail the feasibility of implementing the penetrator concept. The penetrator system and mission designs have been developed and iterated in sufficient detail to provide a high level of confidence that the concept can be implemented within the constraints of the Mariner Mark 2 spacecraft.

1570 **(NIKHEF-H—86-17) Evaluation of the OSI LD1200 optical diskdrive.** Burger, J.M. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). 29 Aug 1986. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780121/JAW.

This document describes the testing of a laser-diskdrive of Optical Storage International, model LD1200. The aim was to test the hardware and media reliability and to verify some of the vendor supplied specifications. (Auth.). 6 refs., 4 figs., 3 tabs.

1571 **(PNL-SA—14905) Computer controlled testing and calibration of health physics instruments.** Swinth, K.L.; Sisk, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 5p. (CONF-871005—5). NTIS, PC A02/MF A01. Order Number DE89001514/JAW.

From Nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

A microcomputer-controlled CAMAC system has been adapted for automated testing and calibration of health physics survey instruments. Once the survey instrument is mounted, the system automatically performs tests for angular dependence or ge-

ometry dependence. Positioning the instruments is performed by a computer-controlled stepping motor, readout is performed by an auto-ranging digital voltmeter, and data is stored on computer disks. 3 refs., 6 figs.

1572 **(RAL—88-060) Silicon pixel detector with routing for external VLSI read-out.** Thomas, S.L.; Seller, P. (Rutherford Appleton Lab., Chilton (UK)). Jul 1988. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755445/JAW.

A silicon pixel detector with an array of 32 by 16 hexagonal pixels has been designed and is being built on high resistivity silicon. The detector elements are reverse biased diodes consisting of p-implants in an n-type substrate and are fully depleted from the front to the back of the wafer. They are intended to measure high energy ionising particles traversing the detector. The detailed design of the pixels, their layout and method of read-out are discussed. A number of test structures have been incorporated onto the wafer to enable measurements to be made on individual pixels together with a variety of active devices. The results will give a better understanding of the operation of the pixel array, and will allow testing of computer simulations of more elaborate structures for the future.

1573 **(SLAC-PUB—4701) Silicon PIN diode array hybrids for charged particle detection.** Shapiro, S.L.; Dunwoodie, W.M.; Arens, J.F.; Jernigan, J.G.; Gaalema, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 20p. (CONF-8806257—1). NTIS, PC A02/MF A01. Order Number DE89002073/JAW.

From Pixel Detector workshop; Leuven, Belgium (1 Jun 1988).

We report on the design of silicon PIN diode array hybrids for use as charged particle detectors. A brief summary of the need for vertex detectors is presented. Circuitry, block diagrams and device specifications are included. 8 refs., 7 figs., 1 tab.

1574 **Prediction and experimental confirmation of the response function for neutron detection using superheated drops.** Lo, Y.; Apfel, R.E. (Yale University, P.O. Box 2159, Yale Station, New Haven, Connecticut 06520). *Physical Review [Section] A: General Physics;* **38**: No. 10, 5260-5266(15 Nov 1988).

Neutrons can be detected with a suspension of superheated drops in an immiscible and compliant holding medium. The mechanism of this radiation-induced bubble nucleation has been studied. A model to predict the minimum neutron energy required to nucleate a vapor bubble in superheated liquids has previously been reported [R.E. Apfel, S. C. Roy, and Y.-C. Lo, Phys. Rev. A 31, 3194 (1985)]. Now, the energy-dependent response function for the detector has been calculated based on the model and a detailed consideration of the possible interactions of neutrons with superheated materials. The response of the detector has been measured with monoenergetic neutrons (from 0.025 eV to 14 MeV) at facilities of the National Bureau of Standards and the Radiological Research Accelerator Facility at the Nevis Laboratories of Columbia University. The experimental results agree reasonably well with that of the calculations.

1575 **Improving health physics measurements by performance testing.** Swinth, K.L.; Roberson, P.L.; MacLellan, J.A. (Pacific Northwest Lab., Richland, WA (USA)). *Health Physics;* **55**: No. 2, 197-205(Aug 1988).

Testing standards have been written to establish minimum performance requirements for personnel dosimeters, radiation survey instruments and bioassay laboratory measurements. These standards were subjected to experimental evaluation and to a consensus review to ensure that the requirements were practical. Programs have been established, using the personnel dosimeter standards, to improve and control the performance of dosimeter processors. Similar implementation of performance testing of instruments will improve reliability of field measurements. Initiation of a program based on the bioassay standard will improve the accuracy, precision, and detectability levels for measuring radioactivity in occupationally exposed workers. Evaluating the performance of health-physics measurement tools will improve the accuracy and precision of measurement and add to our knowledge of personnel exposures. Performance testing will become a more widely recognized tool for maintaining high-quality programs, and the concept will be applied to other measurements as well.

1576 **Improved wire chamber.** Atac, M. US Patent Application 6-049,058. 12 May 1987. 14p. Contract AC02-76CH03000. NTIS, PC A03/MF A01.

An improved gas mixture for use with proportional counter devices, such as Geiger-Mueller tubes and drift chambers. The improved gas mixture provides a stable drift velocity while eliminating wire aging caused by prior art gas mixtures. The new gas mixture is comprised of equal parts argon and ethane gas and having approximately 0.25% isopropyl alcohol vapor. 2 figs.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 631, 1611

1577 **(AD-A—195968/3/XAB) Radiation-protection factors of selected light vehicles against residual radiation. Final report.** Caton, H.; Morrissey, J.A. (Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab.). Jan 1988. 24p. (BRL-TR—2885). NTIS, PC A03/MF A01.

This report summarizes calculations made to determine the factors needed to correct the in-vehicle Radiation Detection Identification and Computation Meter (RADIAC) dose readings to the outside environment. The methodology used is a modified VCS approach and is fully described. The VCS calculation produces a gamma protection factor for a 2-day-old fallout spectrum lying on the ground-surface exterior of the vehicle. This protection factor can be used to correct the in-vehicle RADIAC dose level readings to produce the exterior free-field dose level. The results present not only the correction factors but also several spectra comparisons for in-vehicle and exterior free-field. The calculated correction values are shown.

1578 **(SAND—88-0556C) Coupling of ESD-generated EMP [electromagnetic pulse] to electronics.** Boverie, B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 13p. (CONF-880919—1). NTIS, PC A03/MF A01. Order Number DE89001372/JAW.

From 10. annual electrical overstress/electrostatic discharge symposium; Anaheim, CA, USA (27 Sep 1988).

Electrostatic discharges (ESD) can generate an electromagnetic pulse (EMP) which can couple into electronic circuits. Analytical and experimental models of this coupling demonstrate that, under some circumstances, the energy coupled to an integrated circuit on a printed circuit board is proportional to the product of the peak E- field and the derivative of the E-field. 4 refs., 3 figs.

1579 **Time-resolved thermal annealing of interface traps in aluminum gate-silicon oxide-silicon devices.** Burte, E.P.; Matthies, P. (Fraunhofer Arbeitsgruppe fur Integrierte Schaltungen, Artilleriestrasse 12, D-8520 Erlangen (DE)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **35**: No. 5, 1113-1120(Oct 1988).

Anneal kinetics of interface traps in aluminum gate-silicon oxide-silicon structures has been studied using capacitance-voltage measurements. The capacitors were annealed in forming gas at temperatures ranging from 250°C to 620°C. An exponential decay of the trap density with annealing time has been observed. The curve of the equilibrium value of trap density obtained after long annealing times versus temperature shows a U-shaped form with a minimum located near 450°C. A model based on the bimolecular reaction theory is proposed to explain the obtained results.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 23, 250, 492, 934, 951, 974, 975, 1216, 1295, 1368, 1369, 1370, 1371, 1372, 1373, 1386, 1415, 1445, 1446, 1447, 1448, 1449, 1450, 1452, 1461, 1476, 1816, 2254, 2423, 2565

1580 **(AD-A—196181/2/XAB) Prism laser light-scattering spectrometer.** Chu, B.; Xu, R.; Maeda, T.; Dhadwal, H.S. (State Univ. of New York, Stony Brook (USA)). May 1988. 10p. NTIS, PC A02/MF A01.

Pub. in Review of Scientific Instruments, Vol. 59, No. 5, 716-725(May 1988).

A prism light-scattering spectrometer capable of measuring both the angular distribution of scattered intensity and Rayleigh linewidth is described. The spectrometer employs a unique prism light-scattering cell capable of making small-angle self-beating dynamic light-scattering measurements down to a scattering angle of 2 and is able to achieve an optical coherence factor beta approx. 0.9 routinely, with the theoretical limit for beta being 1. The prism light-scattering cell also permits refractive-index measurements in the 1.33-1.60 range to a precision of 8 x 10^{-7} using a single-axis lateral position sensor. It is a flow cell with potential as a detector for other analytical techniques once the cell volume can be minimized. The apparatus can be controlled by a computer for measurements, as well as acquisition, display, computation, and storage of data.

1581 **(BARC—1409) New approach to the direct digitization of low current.** Vora, H.S.; Das, T.N.; Kumbhare, M.N. (Nuclear Research Lab., Srinagar (India)). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704412/JAW.

The operation of a new current digitizer circuit is described in detail. With its direct but simple approach, the accuracy of measurement of low dc has been improved. At an input current 30 nA, the standard deviation was 0.07 per cent of the mean. With its wide linear response from pico to milli ampere and direct compatability to all types of current sources including photomultipliers, its potential uses and applications are discussed. (author). 9 refs., 5 figs.

1582 **(ITEF—159(1987)) SM-1420 computer conjugation with the ES-5017 magnetic tape storage device and the SM-6313 printer.** Zhurkin, V.V.; Safonov, A.A.; Troitskij, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704577/JAW.

The flow sheets are given and the methods of the technical implementation of expansion units of SM 5002.4 controllers to connect NML ES-5017 and analogue-digital printer ATsPU SM-6818, respectively, to SM-1420 computer are described. 6 refs.; 3 figs.

1583 **(N—88-23895) Noncontact Temperature Measurement.** Lee, M.C. (National Aeronautics and Space Administration, Washington, DC (USA)). Mar 1988. 429p. (NASA-CP—2503; NAS—1.55:2503; CONF-8704325—). NTIS, PC A19/MF A01.

From Noncontact temperature measurement conference; Washington, DC, USA (30 Apr 1987).

Noncontact temperature measurement has been identified as one of the eight advanced technology development (ATD) areas to support the effort of the Microgravity Science and Applications Division in developing six Space Station flight experiment facilities. This two-day workshop was an opportunity for all six disciplines to present their requirements on noncontact temperature measurement and to discuss state-of-the-art developments. Multi-color pyrometry, laser pyrometry and radiometric imaging techniques are addressed.

1584 (N—88-23895, pp vp) **Radiation thermometry: the measurement problem.** Nutter, G.D. Mar 1988. NTIS, PC A19/MF A01. (NASA-CP—2503; NAS—1.55:2503; CONF-8704325—).

From Noncontact temperature measurement conference; Washington, DC, USA (30 Apr 1987).

An overview of the theory and techniques of radiometric thermometry is presented. The characteristics of thermal radiators (targets) are discussed along with surface roughness and oxidation effects, fresnel reflection and subsurface effects in dielectrics. The effects of the optical medium between the radiating target and the radiation thermometer are characterized including atmospheric effects, ambient temperature and dust environment effects and the influence of measurement windows. The optical and photodetection components of radiation thermometers are described and techniques for the correction of emissivity effects are addressed.

1585 (N—88-23895, pp vp) **NBS scale of radiance temperature.** Waters, W.R.; Walker, J.H.; Hattenburg, A.T. Mar 1988. NTIS, PC A19/MF A01. (NASA-CP—2503; NAS—1.55:2503; CONF-8704325—).

From Noncontact temperature measurement conference; Washington, DC, USA (30 Apr 1987).

The measurement methods and instrumentation used in the realization and transfer of the International Practical Temperature Scale (IPTS-68) above the temperature of freezing gold are described. The determination of the ratios of spectral radiance of tungsten-strip lamps to a gold-point blackbody at a wavelength of 654.6 nm is detailed. The response linearity, spectral responsivity, scattering error, and polarization properties of the instrumentation are described. The analysis of the sources of error and estimates of uncertainty are presented. The assigned uncertainties (three standard deviations) in radiance temperature range from + or - 2 K at 2573 K to + or - 0.5 K at 1073 K.

1586 **(N—88-25424) SAMEX vector magnetograph: a design study for a space-based solar vector magnetograph.** Hagyard, M.J.; Gary, G.A.; West, E.A. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Jun 1988. 437p. (NASA-TM—4048; NAS—1.15:4048). NTIS, PC A19/MF A01.

This report presents the results of a pre-phase A study performed by the Marshall Space Flight Center (MSFC) for the Air Force Geophysics Laboratory (AFGL) to develop a design concept for a space-based solar vector magnetograph and hydrogen-alpha telescope. These are two of the core instruments for a proposed Air Force mission, the Solar Activities Measurement Experiments (SAMEX). This mission is designed to study the processes which give rise to activity in the solar atmosphere and to develop techniques for predicting solar activity and its effects on the terrestrial environment.

1587 **(N—88-27121) Space infrared telescope facility project. Final technical report, 1 August 1986-8 January 1988.** Cruikshank, D.P. (Hawaii Univ., Honolulu (USA)). Jul 1988. 35p. (NASA-CR—183058; NAS—1.26:183058). NTIS, PC A03/MF A01.

The functions undertaken during this reporting period were: to inform the planetary science community of the progress and status of the Space Infrared Telescope Facility (SIRTF) Project; to solicit input from the planetary science community on needs and requirements of planetary science in the use of SIRTF at such time that it becomes an operational facility; and a white paper was prepared on the use of the SIRTF for solar system studies.

1588 **(UCRL—97098) Combined microstructure x-ray optics: Multilayer diffraction gratings.** Barbee, T.W. Jr. (Lawrence Livermore National Lab., CA (USA)). May 1988. Contract W-7405-ENG-48. 10p. (CONF-871124—105). NTIS, PC A02/MF A01. Order Number DE89001501/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Multilayers are man-made microstructures engineered to vary in depth that are now of sufficient quality to be used as x-ray, soft x-ray and extreme ultraviolet optics. Gratings are in-plane man-made microstructures which have been used as optic elements for most of this century. Joining of these two optical elements to form combined microstructure optics has the potential for greatly enhancing both the resolution and the throughput attainable in these spectral ranges. Experimental results for multilayer gratings are presented and discussed. It will be demonstrated that multilayer dif-

fraction gratings act as x-ray prisms and are high efficiency dispersion elements. 9 refs., 5 figs.

1589 **(UCRL—98945) The AMS [Accelerator Mass Spectrometer] program at LLNL.** Proctor, I.D. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 9p. (CONF-881151—19). NTIS, PC A02/MF A01. Order Number DE89001715/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

Livermore will have an operational Accelerator Mass Spectrometer (AMS) by mid-1989 as part of its new Multi-user Tandem Laboratory. The spectrometer was designed primarily for applications in archaeology and the geosciences and was co-funded by the University of California Regents. Radiological control for personnel protection, ion sources and injection systems, the tandem and all beam handling hardware are operated with a distributed processor computer control system. The Tandem is the former University of Washington injector FN which has been upgraded with Dowlish tubes, pelletron charging and SF_6 gas. Design goals for the AMS system, computer aided operation, automated measurement capability, initial results and some of our intended applications will be presented. 5 refs., 2 figs.

1590 **(UCRL—99468) A comparison of flat-field measurement techniques for optical streak cameras.** Montgomery, D.S.; Wiedwald, J.D. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 6p. (CONF-880887—24). NTIS, PC A02/MF A01. Order Number DE89001298/JAW.

From 32. international technical symposium on optical and opto-electronic applied sciences and engineering; San Diego, CA, USA (14 Aug 1988).

A technique for calibrating the flat-field response and geometric distortion of optical steak cameras using high-power lasers and electro-optic pulse shaping hardware was reported previously. The laser hardware provides a temporally-flat light pulse that can be used to calibrate streak cameras operating with sweep durations of 3- 10 ns. Although this technique is successful, the hardware involved is expensive and the process is complex. Based on the analysis of calibrations made at these fast sweep rates, we developed a new technique to measure the flat-field response of an optical streak camera using an array of visible light emitting diodes (LED) and a slow ({approximately}10μs) sweep generator. We will discuss the new slow technique, and will present a comparison between calibration measurements made using the two techniques. 6 refs., 5 figs.

1591 **Acoustoelectric interaction of plate modes with solutions.** Niemczyk, T.M.; Martin, S.J.; Frye, G.C.; Ricco, A.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **64**: No. 10, 5002-5008(15 Nov 1988).

Acoustic plate mode (APM) devices operating in liquids have an associated electric field which extends several micrometers into the liquid and is capable of interacting with ions and dipoles in solution. Experiments have been performed using quartz APM devices which demonstrate these acoustoelectric interactions. Changes in the dielectric constant or conductivity of solutions in contact with the device were found to perturb the propagation velocity of the plate mode. An equivalent circuit is proposed to describe the interaction of the electric field with ions and dipoles. From this simple model we obtain the velocity shift and attenuation which should occur as a result of this interaction and compare the model predictions to the experimentally observed trends.

1592 **Two-tone optical heterodyne spectroscopy using buried double heterostructure lead—salt diode lasers.** Silver, J.A.; Stanton, A.C. (Southwest Sciences, Inc., 1570 Pacheco Street, Santa Fe, New Mexico 87501). *Applied Optics;* **27**: No. 21, 4438-4444(1 Nov 1988).

Two-tone optical heterodyne detection using single mode buried double heterostructure lead—salt diode lasers is studied. Residual amplitude modulation with these lasers is found to be substantially smaller than has been noted in previous work with mesa stripe lasers, permitting improved sensitivity for measurement of small optical absorption. Minimum detectable absorption well below 10/sup -5/ is measured at a laser power of 3 μW, in good agreement with signal-to-noise calculations using the experimental values of the FM and AM modulation indices. Optical heterodyne detection with two-tone modulation at 145 and 155 MHz is found to be nearly an order of magnitude more sensitive than conventional second harmonic detection at kilohertz frequencies. In addition to improved detection sensitivity, the double heterostructure lasers offer the important advantages of single mode operation above liquid nitrogen temperature.

1593 **Linearization of scan velocity of resonant vibrating-mirror beam deflectors.** Chen, S.L.; Yeung, E.S. (Ames Laboratory: United States Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Review of Scientific Instruments;* **59**: No. 11, 2393-2396(Nov 1988).

The sinelike behavior of the scan velocity of resonant vibrating-mirror beam deflectors can be linearized by external optics. A good approximation can be achieved by reflection off an elliptical mirror after the deflector. With a moderately large major-to-minor-axes ratio, a substantial linear region is found over the total scan range in typical deflectors. Numerical simulations are presented to show how linearization can be optimized for a given scan requirement.

1594 **Compact wide-aperture hyperbolic analyzers.** Curtis, C.C.; Hsieh, K.C. (Department of Physics, University of Arizona, Tucson, Arizona 85721). *Review of Scientific Instruments;* **59**: No. 11, 2424-2428(Nov 1988).

Compact electrostatic analyzers that employ a new geometry are described. They accept collimated beams of ions through relatively wide (non-slit-like) inlet apertures and focus them at various locations, depending on the ion energy per charge, along rectangular position-sensing detectors. Each analyzer has a dynamic range of 10 or more for a fixed deflection voltage. The focal line width at a given energy is a small fraction of the inlet aperture width, and the focal lines are approximately coplanar.

1595 **On the fifth order aberration in a sextupole corrected probe forming system.** Shao, Z. (Department of Physics and Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637). *Review of Scientific Instruments;* **59**: No. 11, 2429-2437(Nov 1988).

The mechanisms of the generation of the fifth order aberrations in a sextupole corrected electron optical system are carefully analyzed, and a new principle is presented to compensate the rotationally symmetric part of the fifth order aberration. A numerical simulation shows that the probe radius can be reduced from 0.8 A to about 0.4 A for 200-keV electrons by using an additional round lens.

1596 **Noninvasive optical probe for detecting electrical signals in silicon IC's.** Heinrich, H.K.; Hemenway, B.R.; Marsland, R.A.; Bloom, D.M. (IBM, T.J. Watson Research Center, Yorktown Heights, NY (USA)). pp 1161-1165 of Review of progress in quantitative nondestructive evaluation. Volume 7B. Thompson, D.O.; Chimenti, D.E. (eds). New York, NY; Plenum Press (1988). (CONF-870691—).

From 14. annual review of progress in quantitative non-destructive evaluation; Williamsburg, VA, USA (22 Jun 1987).

A 1.3 micrometer optical probing system was developed to detect electrical signals in silicon integrated circuits. Free carriers within integrated active devices perturbed the refractive index of the material and a Nomarski interferometer was used to sense this perturbation. Typical charge-density modulation in active devices also produced a substantial index perturbation and this led to the use of an InGaAsP semiconductor laser to observe real time 0.8V digital signals applied to a bipolar transistor. These signals were detected with a signal-to-noise ratio of 20 dB in a system detection bandwidth of over 200 Mhz.

1597 **Method for in-situ restoration of platinum resistance thermometer calibration.** Carroll, R.M. US Patent Application 6-111,489. 23 Oct 1987. 14p. Contract AC05-84OR21400. NTIS, PC A03/MF A01.

A method is provided for in-situ restoration of platinum resistance thermometers (PRT's) that have undergone surface oxide contamination and/or stain-related damage causing decalibration. The method, which may be automated using a programmed computer control arrangement, consists of applying a dc heating current to the resistive sensing element of the PRT of sufficient magnitude to heat the element to an annealing temperature and maintaining the temperature for a specified period to restore the element to a stress-free calibration condition. The process anneals the sensing element of the PRT without subjecting the entire PRT assembly to the annealing temperature and may be used in the periodic maintenance of installed PRT's. 1 fig.

1598 **X-ray beamsplitter.** Ceglio, N.M.; Stearns, D.G.; Hawryluk, A.M.; Barbee, T.W. Jr. US Patent Application 6-082,468. 7 Aug 1987. 19p. Contract W-7405-ENG-48. NTIS, PC A03/MF A01.

An x-ray beamsplitter which splits an x-ray beam into two coherent parts by reflecting and transmitting some fraction of an incident beam has applications for x-ray interferometry, x-ray holography, x-ray beam manipulation, and x-ray laser cavity output couplers. The beamsplitter is formed of a wavelength selective multilayer thin film supported by a very thin x-ray transparent membrane. The beamsplitter resonantly transmits and reflects x-rays through thin film interference effects. A thin film is formed of 5--50 pairs of alternate Mo/Si layers with a period of 20--250 A. The support membrane is 10--200 nm of silicon nitride or boron nitride. The multilayer/support membrane structure is formed across a window in a substrate by first forming the structure on a solid substrate and then forming a window in the substrate to leave a free-standing structure over the window. 6 figs.

1599 **Normal incidence x-ray mirror for chemical microanalysis.** Carr, M.J.; Romig, A.D. Jr. US Patent Application 6-081,964. 5 Aug 1987. 11p. Contract AC04-76DP00789. NTIS, PC A03/MF A01.

An x-ray mirror for both electron column instruments and micro x-ray fluorescence instruments for making chemical, microanalysis comprises a non-planar mirror having, for example, a spherical reflecting surface for x-rays comprised of a predetermined number of alternating layers of high atomic number material and low atomic number material contiguously formed on a substrate and whose layers have a thickness which is a multiple of the wavelength being reflected. For electron column instruments, the wavelengths of interest lie above 1.5nm, while for x-ray fluorescence instruments, the range of interest is below 0.2nm. 4 figs.

1600 **Self-cleaning rotating anode x-ray source.** Paulikas, A.P. US Patent Application 6-056,825. 2 Jun 1987. 16p. Contract W-31109-ENG-38. NTIS, PC A03/MF A01.

A self-cleaning rotating anode x-ray source comprising and evacuable housing, a rotatable cylindrical anode within the housing, a source of electrons within the housing which electrons are caused to impinge upon the anode to produce x-rays, and means for ionizing residual particles within the housing and accelerating such ions so as to impinge upon the anode to sputter impurities from the surface thereof. 2 figs.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 250, 1884

1601 **Seismic sources.** Green, M.A.; Cook, N.G.W.; McEvilly, T.V.; Majer, E.L.; Witherspoon, P.A. US Patent Application 6-039,887. 20 Apr 1987. 19p. Contract AC03-76SF00098. NTIS, PC A03/MF A01.

Apparatus is described for placement in a borehole in the earth, which enables the generation of closely controlled seismic waves from the borehole. Pure torsional shear waves are generated by an apparatus which includes a stator element fixed to the borehole walls and a rotor element which is electrically driven to rapidly oscillate on the stator element to cause reaction forces transmitted through the borehole walls to the surrounding earth. Longitudinal shear waves are generated by an armature that is driven to rapidly oscillate along the axis of the borehole, to cause reaction forces transmitted to the surrounding earth. Pressure waves are generated by electrically driving pistons that press against opposite ends of a hydraulic reservoir that fills the borehole. High power is generated by energizing the elements for more than about one minute. 9 figs.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

1602 **(AD-A—195964/2/XAB) Design of a combined-effects simulator. Final report, December 1984-September 1987.** Rinehart, E.J.; Rocco, J.R.; Thomsen, J.M. (California Research and Technology, Albuquerque, NM (USA)). May 1988. 95p. NTIS, PC A05/MF A01.

A methodology for designing simulators to model the combined effects of both airblast-induced and direct-induced ground shock is presented. The report describes how to combine the HEST and DIHEST to make a combined-effects simulator. In addition to discussing a general methodology, the report describes how a specific combined effects simulator (CDC-2) was designed. A Combined-Effects Simulator (CES) is an array of high explosives designed to simulate, in a prescribed manner, the total nuclear environment either at a particular point, or in a global sense. The nuclear environment can be conveniently broken down into three basic components; each component is usually simulated with a particular type of simulator and, thus, the CES is truly a combination of both effects and simulators. The effects and most common simulator used to produce the effects are: local airblast, upstream airblast, and source induced motions. (JHD)

1603 **(AD-A—196324/8/XAB) Long-range seismic recording of the MISTY PICTURE high-explosive test, White Sands Missile Range, New Mexico. Environmental research papers, February 1987-February 1988.** Cipar, J. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 4 Feb 1988. 29p. (AFGL-TR—88-0033). NTIS, PC A03/MF A01.

The Solid Earth Geophysics Branch of the Air Force Geophysics Laboratory recorded the MISTY PICTURE high-explosive test at nine sites in the Tularosa Basin of southern New Mexico. Each site consisted of a three-component seismometer set and a digital-event recorder. The stations were due south of the explosion between 95 and 127 km. Analysis of P-wave travel times indicates that the crust is 30-32 km thick beneath the Tularosa Basin, a side graben of the Rio Grande Rift. S-wave travel times are consistent with earlier surface-wave results. Polarization analysis indicates complex scattered and converted energy between the P- and S-wave groups.

1604 **(DOE/CE—15297-T1) Assistance in MSD Research and Development: Part 1, Small scale research, development and testing: Final report.** Worsey, P.N.; Conon, C. (Incubator Technologies, Inc., Rolla, MO (USA); Missouri Univ., Rolla (USA). Rock Mechanics and Explosives Research Center). Mar 1988. Contract FG01-86CE15297. 38p. NTIS, PC A03; 3; GPO Dep. Order Number DE88014586/JAW.

The development and testing of a simple mechanical stemming aid is described. The aid comprises a solid unit placed in the stemming above the explosive column and is designed to improve blasting efficiency and reduce drilling and blasting costs. It is designed to work with back filled drill cuttings or any other suitable stemming material. To date it has consisted of the testing of the aid in small diameter (1.5 and 1.625 inch) holes in Jefferson City Dolomite for both bench and crater blasting configurations. Full scale field trials are being conducted nearby in similar rock in an aggregate quarry. The data acquisition equipment used in Phase 1 included both a Spin Physics SP2000 high speed video motion analysis system and acoustic and seismic monitoring units. Measurements for each test included peak air over pressure, ground surface ppv, stemming displacement and velocity and face movement and extent. The results illustrate that the concept is sound and that its successful application to production blasting at full scale will be a function of manufacturing cost, the development of suitable insertion tech-

niques for large diameter boreholes and the selection of a suitable low cost material for the aid. 17 refs., 20 figs.

1605 **(DOE/CE/15297—T2) Assistance in MSD Research and Development: Part 2, Full scale field testing at mining operations: Final report.** Worsey, P.N.; Canon, C. (Incubator Technologies, Inc., Rolla, MO (USA); Missouri Univ., Rolla (USA). Rock Mechanics and Explosives Research Center). Jun 1988. Contract FG01-86CE15297. 103p. NTIS, PC A06; 3; GPO Dep. Order Number DE88014589/JAW.

Full scale and field testing of a simple mechanical stemming aid is described. The aid comprises a solid unit placed in the stemming above the explosive column and is designed to improve blasting efficiency and reduce drilling and blasting costs. It is designed to work with back filled drill cuttings or any other suitable stemming material. The results of Phase I testing were highly successful, indicating that the stemming aid has technically an extremely good chance of success at full scale when constructed of low cost materials. Phase II of the stemming aid research and development program comprised of the testing of various forms of the stemming is at full scale in non-research oriented i.e. field settings. The stemming aid was field tested at 4 different sites for a variety of mining application: First in underground workings at the UMR experimental mine in one and three quarter inch diameter horizontal blast holes incorporated into full blast patterns; three and three and a half inch blast holes at two crushed rock/limestone quarries in the Rolla area and at a surface coal mine operation run by Peabody Coal Company at Lynnville, Indiana in which nine and seven eighths, ten and five eighths and fifteen and a quarter inch diameter blast holes were used for parting and overburden removal. 2 refs., 37 figs., 11 tabs.

1606 **(LA—11352-MS) Initiation and detonation of heterogeneous high explosives: a unified model.** Tang, P.K. (Los Alamos National Lab., NM (USA)). Sep 1988. Contract W-7405-ENG-36. 15p. NTIS, PC A03/MF A01. Order Number DE89002107/JAW.

Reaction processes in initiation and detonation of heterogeneous high explosives can be characterized by three dominant rates that represent the special chemical and physical features found in various stages of the reaction: hot spot, propagation, and slow process. The first two stages control mainly the initiation; the last manifests itself in what is known as the nonsteady detonation. Three principal rate equations are thus constructed using the process time concept. Examples with triaminotrinitrobenzene-based explosives are presented to illustrate the model capability in the simulations of initiation and detonation. 11 refs., 9 figs.

1607 **3-nitro-1,2,4-triazol-5-one: A less sensitive explosive.** Lee, Kien-Yin; Coburn, M.D. US Patent Application 6-009,165. 30 Jan 1987. 11p. Contract W-7405-ENG-36. NTIS, PC A03/MF A01.

A less sensitive explosive, 3-nitro-1,2,4-triazol-5-one. The compound 3-nitro--1,2,4-triazol-5-one (NTO) has a crystal density of 1.93 g/cm^3 and calculated detonation velocity and pressure equivalent to those of RDX. It can be prepared in high yield from inexpensive starting materials in a safe synthesis. Results from initial small-scale sensitivity tests indicate that NTO is less sensitive than RDX and HMX in all respects. A 4.13 cm diameter, unconfined plate-dent test at 92% of crystal density gave the detonation pressure predicted for NTO by the BKW calculation. 3 tabs.

4502 Nuclear

REFER ALSO TO CITATION(S) 894, 1617

1608 (ACIESP—60-Vol.1, pp 47) **Historical review of Bikini radiation accident in 1954 and radiation protection in Japan.** Kumatori, T. (Radiation Effects Association, Tokyo (Japan)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1609 **(AD-A—195662/2/XAB) Operational reserve: what should it be used for.** Turner, A.F. (Army Command and General Staff Coll., Fort Leavenworth, KS (USA). School of Advanced Military Studies). 8 May 1988. 56p. NTIS, PC A04/MF A01.

This monograph discusses the operational reserve and the roles in which it can be employed. If war occurs in Central Europe, the out-numbered forces of NATO will face a situation where the operations of the reserve will be critical to the outcome of the war. The monograph first examines operational theory and its discussion of the reserve. It then briefly reviews the missions specified for the reserve in tactical level doctrine. Using that as a basis, the monograph studies the differences between a tactical and an operational reserve. It then suggests other missions that can be assigned to an operational reserve that would meet operational and strategic requirements. Included in the discussion is an assessment of the impact of nuclear weapons and future technology on the use of the reserve. Two methods for employing the reserve are suggested. The two methods are applied to historical case studies. A means to assess the utility of the model, and by extension, the use of the reserves both in the past and in the future is then offered. The monograph concludes that the operational reserve should be used in an offensive, or counteroffensive manner. It concludes that its use is a one time only affair and that if employed it should be in a manner that will achieve, or set the precursor for the achievement, of a strategic goal. It concludes that using the operational reserve defensively risks loss of the campaign and the theater.

1610 **(AD-A—196157/2/XAB) Technical papers presented at the Defense Nuclear Agency global effects review - 7-9 April 1987. Volume 1. Technical report.** Alderson, D.M. (Kaman Tempo, Alexandria, VA (USA)). 30 Apr 1987. 405p. NTIS, PC A18/MF A01.

Four years of research on nuclear winter has greatly improved our understanding of this complex phenomenon. Studies have confirmed the possibility of significant temperature decreases and other severe environmental perturbations following a nuclear war. Important uncertainties remain to be resolved: Fuel Inventories: Fuel burdens in rural and urban settings appear to be known to within a factor of about 2. Fuel Impaction: The quantities of fuels affected by nuclear explosions are sensitive to the scenario adopted. Smoke Emission Factor: Burning petroleum, plastics and related materials can emit 5% or more of their mass as soot. Wood, under restricted ventilation, can convert up to 2% to soot. Plume Heights: Simulations and observations indicate initial smoke injection as high as 15 kilometers. Prompt Scavenging: The immediate rainout of the sooty component of smoke emissions is probably less than 50% because of its poor nucleation properties relative to other materials.

1611 **(AD-A—196802/3/XAB) Summary of communication and navigation systems degradation in a nuclear environment.** Knapp, W.S. (General Electric Co., Santa Barbara, CA (USA). TEMPO). 31 May 1979. 83p. (GE—79TMP-22). NTIS, PC A05/MF A01.

Sanitized version.

This handbook summarizes nuclear weapon effects on communication and navigation systems and provides information for determining if sophisticated analyses are required for system evaluation. It replaces DASA 2090.

1612 **(SAND—88-1769C) Strategic Target System (STARS) launch vehicle.** Watts, A.C.; Eno, R.L.; Wente, H.A.; Curtis, C.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-881195—1). NTIS, PC A02/MF A01. Order Number DE89001615/JAW.

From AIAA missile sciences conference; Monterey, CA, USA (28 Nov 1988).

The Strategic Target System (STARS) is being developed primarily as a three-stage solid propellant guided missile derived by integrating selected parts of the retired Polaris A3 fleet ballistic missile and a substantial number of newly developed subsystems. The Polaris A3 parts used are the first and second stage motors with thrust vector control systems (TVCs), interstage sections and nose fairings. New subsystems include: guidance and control

(G&C), flight termination system (FTS) electronics, fusing and firing, TVC servo electronics, telemetry (TM), sequencer, power distribution, third stage motor and third stage structure. STARS is intended to augment diminishing quantities of Minuteman I systems available for testing of development elements of the SDI system. It will be launched from the Department of Energy (DOE)/Sandia National Laboratory (SNL) managed Kauai Test Facility (KTF) located on the Pacific Missile Range Facility (PMRF), Kauai, Hawaii. Reentry vehicle(s) weighing up to 600 lbs in single or multiple configurations will be flown to the broad ocean area (BOA) or targeted to impact or reentry pierce points near the US Army Kwajalein Atoll (USAKA). 12 figs., 3 tabs.

1613 **(SAND—88-2815C) Large scale decontamination of electronic instrumentation.** Metcalf, J.H. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-881140—7). NTIS, PC A03/MF A01. Order Number DE89001506/JAW.

From 2. international symposium on robotics and manufacturing research, education and applications; Albuquerque, NM, USA (16 Nov 1988).

When a nuclear effects test is conducted in one of the tunnel complexes at the Nevada Test Site, large quantities of electronic instrumentation are located underground to amplify, encode and record the signals generated from the experiments. If the radioactive gases produced by the detonation of the nuclear device are not completely contained, the potential exists for radioactive contamination of all or part of this instrumentation. This paper will describe the preparation of an instrumentation decontamination facility and the procedures used in the facility to decontaminate instrumentation with an approximate value of thirty million dollars. 13 figs.

1614 **(UCRL—98468) PACER revisited.** Moir, R.W. (Lawrence Livermore National Lab., CA (USA)). 4 Oct 1988. Contract W-7405-ENG-48. 6p. (CONF-881031—22). NTIS, PC A02/MF A01. Order Number DE89001723/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

This paper discusses a modified version of the PACER concept for power and nuclear material production, which changes the working fluid in the cavity from steam to the molten salt, LiF + BeF_2. In the PACER concept, a 20-kt peaceful nuclear explosion is contained in a cavity about 200 m in diameter, filled with 200 atm of 500{degree}C steam. Energy from the explosion is used to produce power, and the neutrons are used to produce materials such as ^{233}U, Pu, ^{60}Co, and T. The present idea is to modify the PACER concept in three ways, to improve the practicality, predictability, and safety of power production from this technology and thus improve public acceptance of this power source. These improvements are line the cavity with steel; replace the steam with molten salt; and reduce the explosive yield to about 2 kt. This concept is the only fusion power concept where the underiying technology is proven and in hand today. 9 refs., 3 figs., 1 tab.

1615 **(UCRL—99714) Comparison of two rock vaporization models in DYNA2D.** Attia, A.V.; Young, D.A. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 12p. (CONF-881093—6). NTIS, PC A03/MF A01. Order Number DE89001455/JAW.

From Nuclear explosives code developer's conference; Boulder, CO, USA (11 Oct 1988).

Buried burst and underground test containment simulations require hydrocarbons to use a three-phase tabular equation of state (EOS) for a wide variety of rock compositions. Two models are described for treating the vaporization of nonporous rocks: The nonporous EOS tables are used alone, and pressure-compression characteristics, obtained from Hugoniot are linearly mixed with nonporous EOS tables. Results of these two models are compared for the vaporization response of nonporous SiO_2, using the hydrocode DYNA2D. Density-energy paths and pressure-time histories show that both models agree very well, showing that it is sufficient to use the EOS tables alone. 9 refs., 5 figs.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 2001

1616 **(AD-A—196796/7/XAB) Automatic detection and recognition of the first-arrival phase of seismic-event signals contaminated by noise. The curious case of the missing explosion. Final report, 1 February 1985-31 January 1987.** Alden, K.A.; Herrin, E. (Southern Methodist Univ., Dallas, TX (USA). Dallas Geophysical Lab.). 29 Jun 1987. 274p. NTIS, PC A12/MF A01.

Two papers are based upon data collected at the Lajitas Seismic Station. In the first paper a historical perspective on the methods that have been used to automatically detect event signals and pick first arrival times is developed. Then the data set used to characterize and test the detection techniques is described and the features that discriminate seismic signals effectively from the background noise are characterized. Two automatic detection methods are investigated: 1) The AR (8)-Spectral estimates of the signal and noise are used to develop the AR(p)-Spectral estimate for a synthetic waveform; and 2) Several non-parametric tests are employed in a time-domain detector to discriminate event signals from background. The non-parametric detector chosen, RANK 2700, employs a modified rank sum test to locate the seismic event and pick its first arrival time. Errors in the automatic first arrival picks for 152 of the event traces in the data set are used to analyze the performance. The second paper presents a scenario for a clandestine, decoupled nuclear explosion in southeastern New Mexico based upon data recorded at Lajitas and other stations at regional distances from the hypothetical clandestine test.

1617 **(SAND—88-1079) Performance tables for helium-actuated pipe closures.** Bennett, M.D. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1988. Contract AC04-76DP00789. 117p. NTIS, PC A06/MF A01. Order Number DE89001840/JAW.

The one-dimensional translational motion of a large sliding gate driven by 1000-atm helium gas is numerically modeled. The working fluid, which consists of a mixture of the stored helium and the detonation products from the explosive charge that ruptures the walls of the storage vessel, is taken to be a real gas in thermodynamic equilibrium. Based on the measured actuation time of the first two closures of this type employed at the Nevada Test Site, the maximum error in the model is {approximately}2%. 5 refs., 8 figs., 3 tabs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 645, 1727, 2081

1618 **(CEA-CONF—9399) Long term climatic and environmental records from Antarctic ice.** Genthon, G.; Jouzel, J. and others. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). 1987. 21p. (CONF-8708285—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88754968/JAW.

From IUGG conference; Vancouver, Canada (9 Aug 1987).

Various records obtained from the Vostok (East Antarctica) ice core allow to reconstruct temperature, accumulation (precipitation), aerosol loading and atmospheric CO/sub 2/ concentration histories over the last climatic cycle (160,000 years). The Vostok isotope temperature and CO/sub 2/ records show a large 100 kyr signal with changes of the order of 10/sup 0/C and 70 p.p.m.v respectively. They are closely associated and show periodicities which are characteristics of the earth orbital parameters. These features suggest the existence of a fundamental link between the climate system and the carbon cycle and point out the possible role of CO/sub 2/, in addition to insolation inputs, in accounting for the observed temperature history.

1619 **(CONF-8809168—1) Monitoring the environment in the 21st century.** Auerbach, S.I. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01. Order Number DE89001191/JAW.

From 2. US-USSR symposium on air pollution effects on vegetation; Gatlinburg, TN, USA (21 Sep 1988).

This document contains the text of a speech on monitoring in the future. The discussion is very general and non-technical in content; the paper contains no detailed information on monitoring techniques. 12 refs. (TEM)

1620 **(PB—88-868229/XAB) Ozone in the stratosphere. January 1977-April 1982 (Citations from the NTIS data base). Report for January 1977-April 1982.** (National Technical Information Service, Springfield, VA (USA)). Aug 1988. 146p. NTIS PC N01/MF N01.

This bibliography contains citations concerning empirical and theoretical studies and analyses of stratospheric ozone. The studies cover data collection and processing related to upper-atmospheric ozone concentrations due to transport, formation, and depletion, using ground-based, airborne, and satellite-borne instrumentation and sensors. The theoretical studies include atmospheric composition, reaction kinetics, particle physics, chemical reactions, photochemistry, and atmospheric models of ozone. The investigations are based upon both the theory of photochemistry and constituents, and on analysis and comparisons of long-term measurement data. (This updated bibliography contains 247 citations, none of which are new entries to the previous edition.)

1621 **(PB—88-868237/XAB) Ozone in the stratosphere. May 1982-August 1988 (Citations from the NTIS data base). Report for May 1982-August 1988.** (National Technical Information Service, Springfield, VA (USA)). Aug 1988. 111p. NTIS PC N01/MF N01.

Supersedes PB—82-808064.

This bibliography contains citations concerning empirical and theoretical studies and analyses of stratospheric ozone. The studies cover data collection and processing related to upper-atmospheric ozone concentrations due to transport, formation, and depletion, using ground-based, airborne, and satellite-borne instrumentation and sensors. The theoretical studies include atmospheric composition, reaction kinetics, particle physics, chemical reactions, photochemistry, and atmospheric models of ozone. The investigations are based upon both the theory of photochemistry and constituents, and on analysis and comparisons of long-term measurement data. Several articles cover the Antarctic October depletion phenomenon. (This updated bibliography contains 172 citations, all of which are new entries to the previous edition.)

1622 **(SNV—3370) Methods of measurement and analysis in settling exterior air quality environment.** Areskoug, H.; Killingmo, O.H.; Johansson, R. (Statens Naturvaardsverk, Nykoeping (SE). Luftlaboratoriet). (National Swedish Environmental Protection Board, Solna). 1987. 237p. (In Swedish). NTIS (US Sales Only), PC A11. Order Number DE88755081/JAW.

The report accounts for different principles of measuring the air pollutants carbon monoxide, nitrogen oxides, ozone, sulfur dioxide, total content particulates and soot in the exterior environment. Also described are measurements of complementary parameters, data recording, installation and service of measuring equipment, and data quality. In appendices are in detail described the measuring methods proposed by the National Swedish Environment Protection Board for control of these air pollutants in relation to the recommended values now being prepared by the Board. (With 53 refs.) (G.B.).

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 2, 13, 28, 29, 30, 31, 32, 35, 36, 37, 313, 400, 401, 402, 532, 580, 805, 865, 1477, 1480, 1488, 1705, 1706, 1743, 1795, 1805, 1816, 1905, 1911, 1971, 1975, 1977, 1979

1623 **(AD-A—195724/0/XAB) Hydrazine loss processes in a teflon-film reaction chamber: laboratory results and kinetic models. Final report, September 1985-September 1987.** Stone, D.A.; Wiseman, F.L. (Air Force Engineering and Services Center, Tyndall AFB, FL (USA). Engineering and Services Lab.). May 1988. 125p. (AFESC/ESL-TR—87-68). NTIS, PC A06/MF A01.

The research described was undertaken to extend knowledge of the chemical transformations of hydrazine vapor in the environment. It is known that both gas-phase and surface-catalyzed reactions can occur with this fuel. To determine the eventual fate of hydrazine vapors that escape into the atmosphere through normal operations or during accidental liquid spills, all of these processes must be investigated. Hydrazine is used extensively in small thrusters for satellites, as a fuel-cell reactant, in emergency power generating units, and as a liquid rocket-fuel component. Both routine handling operations and accidental spills can produce fuel vapors that constitute a substantial health risk. Hydrazine is classified as an animal carcinogen and a suspect human carcinogen. This toxicity is reflected in its low-threshold-limit value, 0.1 parts per million, and has prompted numerous studies of the fate of hydrazine in both atmospheric and terrestrial environments.

1624 **(AD-A—195792/7/XAB) Volatility of aerosols in the western European environment. Interim report No. 4.** Jennings, S.G. (University Coll., Galway (Ireland)). May 1988. 17p. NTIS, PC A03/MF A01.

Volatility measurements of ambient aerosol particles were made nearly continuously at Mace Head Field Station over the period 10-11 March 1988. The air containing the particles was drawn through the fused-quartz tube heated to a temperature of 400 C in about 6 minutes, then allowed to cool for about 44 minutes to a temperature close to ambient and the cycle repeated. A fraction of the particles evaporate and the remainder and/or particle residues then pass through a short section of unheated tubing into a light-scattering aerosol counter (a Particle Measuring Systems Model ASASP-X) where their size and number concentration are measured as a function of temperature. This data is replotted showing temperature dependence of maritime aerosol concentration for five temperature cycles for the later time period for particle counter ranges 3 to 0. The resulting average fractionation curves for submicron particles compare favourably with laboratory data for ammonium sulfate (and ammonium bisulfate). This suggests that these materials are a major constituent of the submicron fraction of maritime aerosols.

1625 **(BNL—41219) Mass-transport limitation to in-cloud reaction rates: Implications of new accommodation coefficient measurements.** Schwartz, S.E. (Brookhaven National Lab., Upton, NY (USA)). Oct 1988. Contract AC02-76CH00016. 42p. (CONF-880912—15). NTIS, PC A03/MF A01. Order Number DE89001607/JAW.

From 196. American Chemical Society national meeting; Los Angeles, CA, USA (25 Sep 1988).

Although it has been recognized for some time that the rate of reactive uptake of gases in cloudwater can depend on the value of the mass-accommodation coefficient (α) describing interfacial mass transport (MT), definitive evaluation of such rates is only now becoming possible with the availability of measurements of α for gases of atmospheric interest at air-water interfaces. Examination of MT limitation to the rate of in-cloud aqueous-phase oxidation of SO_2 by O_3 and H_2O_2 shows that despite the low value of α/sub O3/ (5 {times} 10/sup {minus}4/), interfacial MT of this species is not limiting under essentially all conditions of interest; the high values of α for SO_2 ($\geqq$ 0.2) and H_2O_2 ($\geqq$ 0.08) indicate no interfacial MT limitation for these species also. Although gas- and aqueous-phase MT can be limiting under certain extremes of conditions, treating the system as under chemical kinetic control is generally an excellent approximation. Interfacial MT limitation also is found not

to hinder the rate of H_2O_2 formation by aqueous-phase disproportionation of HO_2. Finally, the rapid uptake of N_2O_5 by cloud droplets implies that the yield of aqueous HNO_3 from in-cloud gas-phase oxidation of $NO_2$by O_3 can be substantial even under daytime conditions. This report consists of copies of viewgraphs prepared for this presentation.

1626 (CONF-8608232—, pp vp) **Detection of biomass burning and smoke plumes in the Amazon region through NOAA satellite imagery.** Pereira, M.C.; Setzer, A.W. 1986. (In several languages). NTIS, PC A99/MF E03.

From 4. Brazilian remote sensing symposium and 6. SELPER plenary meeting; Gramado, Brazil (10 Aug 1986).

Twenty-five NOAA-8 and 9 satellite images covering the Amazon region were recorded from July 19th to August 9th, 1985 and analyzed along with the GTE/ABLE-2A field measurements. The objective was the detection of biomass burnings and smoke plumes to assess the environmental impact caused by their emissions in the atmosphere. The area covered by the smoke varied from 2,800 to 90,000 sq km as the dry season progressed. Maps and slides show the areas affected by the burnings. The methodology proved to be adequate to the detection of large biomass burnings.

1627 (CONF-8809157—1) **The role of US forestry in addressing the CO_2 greenhouse problem.** Marland, G. (Oak Ridge National Lab., TN (USA)). 19 Sep 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01. Order Number DE89000650/JAW.

From U.S. Senate Energy Committee meeting; Washington, DC, USA (19 Sep 1988).

This document describes the magnitude of atmospheric carbon dioxide increases resulting from the burning of fossil fuels. The author calculates the potential mitigating effects of several forest management options. To be most effective in reducing CO_2 levels, major industrial countries would have to shift from fossil fuel base to a wood fuel based economy. 10 refs., 4 figs. (TEM)

1628 (CONF-8809168—2) **Direct responses of forest trees to rising atmospheric carbon dioxide.** Norby, R.J. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01. Order Number DE89002194/JAW.

From 2. US-USSR symposium on air pollution effects on vegetation; Gatlinburg, TN, USA (21 Sep 1988).

In addition to their role in the global carbon cycle, trees are an important commodity, and increased tree growth would be an economic benefit offsetting to some degree the various deleterious effects of climate change. Unlike annual crop plants, individual trees that are planted today will experience substantially higher concentrations of CO_2 during their lifetimes without the opportunity for genetic adaptation, whereas crop plants are constantly bred to perform best in the current CO_2 environment. Reliable information on the capacity for different tree species to respond to rising CO_2 and on the effect of elevated CO_2 on tree responses to climatic change could influence the decisions of forest companies on what species to plant in different regions in order to maximize productivity in an atmosphere different from the atmosphere of today. 32 refs.

1629 (DOE/ER/60635—22, pp 3-10) **Description of the Sequential Chemistry of Rain Experiment-1988, a component of 3CPO.** Bowersox, V.C. Aug 1988. NTIS, PC A03/MF A01. Order Number DE88016484/JAW. (COO—1199-66).

In Study of atmospheric pollution scavenging: Twenty-second progress report.

A cooperative project to measure the chemistry and physics of convective storms was conducted during the period 1 May-30 June 1988 in an 80 km x 80 km area of east-central Illinois near Champaign-Urbana. An organization named the Cloud Chemistry and Cloud Physics Organization, or 3CPO, coordinated the project, which was hosted by the Illinois State Water Survey. SECORE-88, or Sequential Chemistry of Rain Experiment-1988, operated a smaller network of four wet-only sequential samplers and 13 raingage sites. Sites were separated by about 1.1 kilometers and rainfall sequences were collected every .05 cm. The common anions and cations were measured at three locations and at one of these locations, the Bondville site, samples from one sequential sampler were collected exclusively for aqueous H_2O_2 analyses. SECORE-88 stations were nested within the larger PRECP-VI array and measurements were made on a higher time resolution than at PRECP-VI stations. Together data from these two surface networks will be used to address the question of the temporal and spatial variability of wet deposition chemistry from convective cells, storms, and complexes within the area of one grid square of the Regional Acid Deposition Model (RADM). RADM is a predictive Eulerian model that has the capacity to predict wet and dry deposition fluxes given emissions and meteorological data. A primary objective of 3CPO is to provide a data set that can be used for RADM verification purposes.

1630 (DOE/ER/60635—22, pp 11-14) **Procedures for the analysis of aqueous hydrogen peroxide in rain samples collected during SECORE-88.** Bachman, S.R.; Peden, M.E. Aug 1988. NTIS, PC A03/MF A01. Order Number DE88016484/JAW. (COO—1199-66).

In Study of atmospheric pollution scavenging: Twenty-second progress report.

During the Sequential Chemistry of Rain Experiment in the summer of 1988 (SECORE-88), some wet-only deposition samples were collected exclusively for hydrogen peroxide determinations at a rural sampling station near Bondville, IL. In the months of May and June, SECORE-88 operations were a component of the Cloud Chemistry and Cloud Physics Organization (3CPO) field project. Six separate collection events were recorded during SECORE-88, but only the 8 June event occurred during 3CPO activities. One of the measurement objectives of SECORE-88 was to obtain data on the H_2O_2 content of rain samples from convective showers. An efficient method, relatively free of interference, and with sufficient sensitivity to detect aqueous peroxide in rain samples, was sought. A description is included of the techniques employed.

1631 (DOE/ER/60635—22, pp 15-19) **Preliminary data for SECORE-88 Case 1: June 8, 1988.** Bowersox, V.C.; Peden, M.E. Aug 1988. NTIS, PC A03/MF A01. Order Number DE88016484/JAW. (COO—1199-66).

In Study of atmospheric pollution scavenging: Twenty-second progress report.

On 8 June 1988 the 13 rain gages and four sequential chemistry samplers in the SECORE-88 network all recorded the first precipitation event to occur after the network was activated on 20 May 88. Rain fell from a stratiform deck associated with the passage of a mesoscale low that tracked across southern Illinois. The ion concentrations for a set of six major anions and cations in the sample sequences from the three sequential chemistry stations in the SECORE-88 network. Since this rain event was associated with a relatively uniform stratiform cloud layer, resulting in a steady rainfall rate, the correlative behavior of these ion concentrations will be examined both in space and time to address the question of spatial and temporal variability over space scales of several kilometers and time scales of minutes. Clearly there is a strong correspondence between the concentrations of Ca^{2+} and Mg^{2+}, reflecting their common source in rainfall (scavenged soil and road dust aerosols). For the N and S species, which have both gaseous and particulate sources, however, the correspondence is not so strong. Careful analyses of these data will be a first step in the interpretation of the data from two other stratiform cases, one on July 18 and one on July 20, and the three convective rain cases sampled during the month of July.

1632 (DOE/ER/60635—22, pp 20-29) **Research summary report to the National Acid Precipitation Assessment Program - Task Group III activities.** Bowersox, V.C.; Semonin, R.G. Aug 1988. NTIS, PC A03/MF A01. Order Number DE88016484/JAW. (COO—1199-66).

In Study of atmospheric pollution scavenging: Twenty-second progress report.

Studies of the scavenging of atmospheric pollutants that affect the acidity of precipitation have been done in pursuit of the goals of Task Group III: to investigate meteorological and chemical influences on acidic deposition. This effort has focused on the analysis of existing wet deposition data sets, such as NADP/NTN and MAP3S data, that have been collected in response to NAPAP needs to quantify spatial and temporal patterns and trends in wet

deposition. These data sets have been used to identify the important chemical contributions to the ionic balance in precipitation samples, then to examine the influence of meteorological factors and source regions on concentrations of these constituents. Results of this work can provide insight into the important processes that modelers must consider to accurately estimate acidic deposition.

1633 (DOE/ER/60635—22, pp 30-37) **Modified successive corrections method that meets statistical goals.** Su, J.; Stensland, G.J. Aug 1988. NTIS, PC A03/MF A01. Order Number DE88016484/JAW. (COO—1199-66).

In Study of atmospheric pollution scavenging: Twenty-second progress report.

Kriging and statistical methods in general are of great interest to acid rain research. Kriging calculates the interpolation weights by minimizing the standard error of interpolation and provides the uncertainty associated with the interpolated values. This is a powerful tool when comparing two sets of atmospheric chemistry data that vary in space and time. A major drawback of Kriging is the amount of computer resources that it requires. Successive corrections schemes are widely used in numerical weather modeling precisely because they require more modest computer resources. Unfortunately, the available successive corrections methods do not incorporate the uncertainty associated with the data and cannot provide the analyst with a standard error of interpolation, nor can they calculate an optimal set of interpolation weights. It is their aim to implement error estimation for a successive corrections method and to formalize procedures for finding an optimal set of successive corrections parameters, thus maintaining the best of both Krieging and the successive corrections methods.

1634 (DOE/ER/60635—22, pp 38-41) **Dry deposition flux estimates for large-particle elements from dry-bucket measurements.** Gatz, D.F.; Bowersox, V.C.; Su, J. Aug 1988. NTIS, PC A03/MF A01. Order Number DE88016484/JAW. (COO—1199-66).

In Study of atmospheric pollution scavenging: Twenty-second progress report.

There were two main purposes for this work. The first purpose was to explore methods for screening the data set, by: (1) comparing distributions of dry deposition rates in dry uncontaminated samples with those in samples containing various single contaminants (including water), and (2) determining the effects of various screening criteria on the statistical distributions of dry deposition rates measured by the NADP dry bucket samplers. The second main purpose was to derive mean dry deposition fluxes for Ca, Mg, K, and Na for the eastern and western US, and for dusty and clean seasons.

1635 (DOE/ER/60635—22, pp 42-46) **Spatial relationships between acid rain, air quality, and visibility data.** Stensland, G.J. Aug 1988. NTIS, PC A03/MF A01. Order Number DE88016484/JAW. (COO—1199-66).

In Study of atmospheric pollution scavenging: Twenty-second progress report.

Visibility and acid rain are two different phenomena which both have direct relationships to air quality. The objective of this study was to explore the relationships between all three data sets, with emphasis on the situations for the eastern US.

1636 (DOE/ER/60635—22, pp 47-49) **Synthetic precipitation reference samples.** Peden, M.E. Aug 1988. NTIS, PC A03/MF A01. Order Number DE88016484/JAW. (COO—1199-66).

In Study of atmospheric pollution scavenging: Twenty-second progress report.

Although the National Bureau of Standards (NBS) has recently developed a Standard Reference Material (SRM) for precipitation chemistry studies, the NBS solutions (SRM 2694) do not include certified concentration values for nitrate, chloride, or ammonium. SRM's are also relatively expensive, so that their cost becomes prohibitive when they are used for several parameters by several chemists on a daily basis. Another drawback is that the certified concentrations of the parameters in SRM 2694 do not adequately reflect those actually found in wet-only deposition. The original objective of this study was to develop internally formulated reference materials that could be used in conjunction with NBS Standard Reference Materials. The purpose of the NBS reference material program is to provide source materials that can be used to ensure NBS traceability. The high cost of certified standards provided through this program, however, precludes their use on a routine basis to monitor laboratory performance. A review of the certified analytes contained in the NBS SRM for rainwater indicated that many laboratories could benefit from using internally formulated solutions that more closely approximated the concentration levels characteristic of wet deposition. In addition, solutions that contained all of the major ions of interest in precipitation were needed.

1637 (EPA—230-05-86-013, pp 1-35) **Sea level rise and wetland loss: an overview.** Titus, J.G. (Environmental Protection Agency, Washington, DC (USA)). Jul 1988. Unlimited audience, publicly available. United States Environmental Protection Agency, Washington, DC 20465. Order Number TI88015785/JAW.

In Greenhouse effect, sea level rise, and coastal wetlands.

This report examines the vulnerability of US coastal wetlands (excluding Alaska and Hawaii) to a possible rise in seal level of one or two meters through the year 2100. By coastal wetlands, they refer to marshes, swamps, and other plant communities that are flooded part, but not all, of the time, and that are hydraulically connected to the sea. This chapter, written for the general reader, summarizes the other chapters and their implications, as well as the basis for expecting a global warming and rise in sea level; nature's response to a rising sea; the impacts of human interference with the mechanisms by which wetlands adjust to sea level rise; and policies that might limit future loss of coastal wetlands.

1638 (EPA—230-05-86-013, pp 37-59) **Charleston case study.** Kana, T.W.; Baca, B.J.; Williams, M.L. (Coastal Science & Engineering, Inc., Columbia, SC (USA)). Jul 1988. Unlimited audience, publicly available. United States Environmental Protection Agency, Washington, DC 20465. Order Number TI88015785/JAW.

In Greenhouse effect, sea level rise, and coastal wetlands.

This chapter examines the potential impact of future sea level rise on coastal wetlands in the area of Charleston, South Carolina, for the year 2075. The authors investigate the hypothesis that a generally concave marsh profile implies that a rise in sea level would cause a net loss of wetlands. The chapter builds upon previous EPA studies that had assessed the potential physical and economic impacts of sea level rise on the Charleston area. They surveyed twelve wetland transects to determine elevations of particular parts of the marsh, frequency of flooding, and vegetation at various elevations. From these transects, they developed a composite transect representing an average profile of the area. Using this information and estimates of the sediment provided by nearby rivers, they then estimated the shifts in wetland communities and net loss of marsh acreage associated with three possible scenarios of sea level rise for the year 2075: (1) the current trend, which implies a rise of 24 cm (0.8 ft), relative to the subsiding coast of Charleston; (2) a low scenario of 87 cm (3.0 ft); and (3) a high scenario of a 159-cm rise (5.2 ft). They examine background information concerning global warming and future sea level rise, the ecological balance of coastal wetlands, and the potential transformation of these ecosystems as sea level rises. Next, they examine the wetlands in the Charleston study area and describe a field study in which they developed wetland transects. Finally, they discuss the potential impact of future sea level rise on Charleston's wetlands, and suggest ways to improve their ability to predict the impact of sea level rise on other coastal wetlands.

1639 (EPA—230-05-86-013, pp 61-86) **New Jersey case study.** Kana, T.W.; Eiser, W.C.; Baca, B.J.; Williams, M.L. (Coastal Science & Engineering Inc., Columbia, SC (USA)). Jul 1988. Unlimited audience, publicly available. United States Environmental Protection Agency, Washington, DC 20465. Order Number TI88015785/JAW.

In Greenhouse effect, sea level rise, and coastal wetlands.

This study examines the potential impact of future sea level rise on coastal wetland in the area around Tuckerton, New Jersey. They gathered data on the vegetation at various elevations within the marsh, and then developed a composite transect representing an

average profile of the area. Using this information and estimates of the sediment provided by nearby marshes, they then estimated the shifts in wetland communities and net loss of marsh acreage associated with three possible scenarios of sea level rise for the year 2075: the current sea level trend and worldwide rises in sea level of 66 and 138 centimeters (cm) (2.2 and 4.5 ft) by 2075, which would imply rises of 87 and 159 cm (2.9 and 5.2 ft) around South Central New Jersey, allowing for local effects. While emphasizing site-specific data, the results presented in this study provide some interesting contrasts with higher tidal range areas, which should prove useful in studies of other wetlands in microtidal settings. It was not the intent of this study, or of the Charleston study, to provide a detailed species inventory or a refined model of marsh zonation and primary productivity. Rather, their concern was to develop some applicable relationships between the predominant marsh species and corresponding intertidal elevations. Their field surveys were site-specific for the Tuckerton/Little Egg Harbor area but can be applied generally to other microtidal marsh environments by normalizing absolute elevations for the local tide range.

1640 (EPA—230-05-86-013, pp 87-149) **Impacts on coastal wetlands throughout the United States.** Armentano, T.V.; Park, R.A.; Cloonan, C.L. (Holcomb Research Institute, Indianapolis, IN (USA)). Jul 1988. Unlimited audience, publicly available. United States Environmental Protection Agency, Washington, DC 20465. Order Number TI88015785/JAW.

In Greenhouse effect, sea level rise, and coastal wetlands.

Although wetland responses to sea level rise can be estimated only in association with uncertainties inherent in making future projections, the major factors controlling wetland sea level responses can be modeled. This chapter considers possible coastal wetland responses to future sea level rise in the conterminous US, in order to provide information needed to understand future threats to coastal resources during an anticipated period of unprecedented climatic change. Their primary objectives have been to interpret their present understanding of wetland adjustments to sea level rise in terms of a future acceleration of present sea level rise rates, and to outline a method for projecting future regional-level responses that could result from global warming. The research focuses on relatively large-scale spatial patterns as opposed to specific site responses. Therefore, local features often are subsumed within more widespread characteristics in order to detect regional trends.

1641 (EPA—230-05-86-013, pp 151-152) **Alternatives for protecting coastal wetlands from the rising sea.** Jul 1988. Unlimited audience, publicly available. United States Environmental Protection Agency, Washington, DC 20465. Order Number TI88015785/JAW.

In Greenhouse effect, sea level rise, and coastal wetlands.

Recognizing the numerous benefits and values accrued to society from wetlands, there are several options available for minimizing potential future losses of wetlands from predicted sea level rise. These protection alternatives focus on methods available to local planners and decision makers who can influence regional efforts to ameliorate the impacts on coastal resources associated with sea level rise. They are: (1) increase wetlands' ability to keep pace with sea level rise; (2) protect coastal barriers; (3) create no-development buffers along the landward edge of wetlands; and (4) construct tide protection systems.

1642 (EPRI-EA—5424) **Materials degradation and acidic deposition: Final report.** Bernabo, J.C.; Smythe, K.D. (Electric Power Research Inst., Palo Alto, CA (USA); Science and Policy Associates, Inc., Washington, DC (USA)). Oct 1988. 146p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI89001771/JAW.

This report reviews the potential role of acidic deposition on the degradation of materials in the United States. The report identifies major types of materials (stone, metals, concrete, painted surfaces, ceramics, rubber) exposed to the outdoor environment, their distribution within the environment, and the nature of deterioration processes that may affect them. The extent to which acidic deposition may accelerate natural deterioration rates is examined, and key uncertainties in scientific understanding of the dose-response relationships are noted. Because of these major uncertainties, the report does not attempt to develop cost estimates for materials damage from acidic deposition. Such estimates would require not only accurate inventories of material usage and dose-response functions for specific pollutant exposures and degradation processes, but also an understanding of consumer maintenance practices and societal adjustments to changes in the durability of materials. The report summarizes the published, peer-reviewed literature on the relation between acidic deposition and materials damage. It also identifies the major uncertainties in scientific knowledge on the role of acidic deposition in degrading materials, and highlights key research programs planned and underway to resolve the major uncertainties. 178 refs., 9 figs., 15 tabs.

1643 (LBL—25808) **Real-time portable organic vapor sampling systems: Status and needs.** Daisey, J.M. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 18p. (CONF-8702158—1). NTIS, PC A03/MF A01. Order Number DE89000565/JAW.

From American conference of governmental industrial hygienists; Pacific Grove, CA, USA (16 Feb 1987).

This paper reviews portable and mobile instruments that are commercially available for real-time VOC monitoring in field situations. Portable instruments for detecting explosive gases, such as methane, ethane, butane, etc., are not reviewed here. A wide variety of detection systems have been used in portable VOC monitors including electrochemical and calorimetric detectors, thermal conductivity, flame ionization, photoionization and electron capture detectors, infrared and ultraviolet light spectrometers and quadrupole and ion-trap mass spectrometers. The instruments reviewed here have been grouped by the type of detection system used. 11 refs., 8 tabs.

1644 (LBL—25832) **Physical and chemical characterization of smoke from several fuels.** Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 8p. (CONF-8810212—1). NTIS, PC A02/MF A01. Order Number DE89001263/JAW.

From Conference on fire: control the heat ... reduce the hazard; London, UK (24 Oct 1988).

This paper summarizes the experimental approaches used and the results obtained at Lawrence Berkeley Laboratory on physico-chemical properties of smokes from several fuels. These experiments were principally designed to contribute to the assessment of environmental consequences of a nuclear war ("nuclear winter"). We believe, however, that the results and the experimental methodology used are of interest to the broader fire research community. The smoke particle sampling and analysis methods were originally developed for studies of atmospheric aerosol particles. In these atmospheric applications, it is important to acquire at a minimum information about particle mass, particle size distribution and chemical composition of the particles as a function of particle size. Which specific chemical species and compounds are analyzed is determined by the objectives of the particular study. Depending on these objectives, specific gaseous compounds may be monitored, particularly those that serve as precursors for the formation of aerosols by various gas-to-particle conversion processes. 6 refs., 4 figs.

1645 (N—88-24112) **Potential impact on atmospheric ozone and temperature of increasing trace gas concentrations.** Brasseur, G.; Derudder, A. (Institut d'Aeronomie Spatiale de Belgique, Brussels). 1987. 100p. (NASA-CR—182965; NAS—1.26:182965; AERONOMICA-ACTA-A—322-1987; ETN—88-92484). NTIS, PC A05/MF A01.

The response of the atmosphere to emissions of chlorofluorocarbons (CFCs) and other chlorocarbons, and to increasing concentrations of other radiatively active trace gases such as CO_2, CH_4, and N_2O is calculated by a coupled chemical-radiative transport one-dimensional model. It is shown that significant reductions in the ozone concentration and in the temperature are expected in the upper stratosphere as a result of increasing concentrations of active chlorine produced by photodecomposition of the CFCs. The ozone content is expected to increase in the troposphere, as a consequence of increasing concentrations of methane and nitrogen oxides. Due to enhanced greenhouse effects, the Earth's surface should warm up by several degrees. The amplitude and even the sign of future changes in the ozone column are difficult to predict as they are strongly scenario-dependent. An early detection system

to prevent noticeable ozone changes as a result of increasing concentrations of source gases should thus be based on a continuous monitoring of the ozone amount in the upper stratosphere rather than on measurements of the ozone column only. Measurements of NOx, Clx, and HOx are also required for unambiguous trend detection and interpretation.

1646 **(ORNL/CDIC—16) The IEA/ORAU Long-Term Global Energy-CO_2 Model: Personal computer version A84PC.** Edmonds, J.A.; Reilly, J.M.; Boden, T.A.; Reynolds, S.E. (Oak Ridge National Lab., TN (USA)). Dec 1986. Contract AC05-84OR21400. 292p. (CMP—002/PC). NTIS, PC A13 - Order software packages from National Energy Software Center, Argonne National Laboratory, 9800 South Cass Avenue, Argonne, IL 60439. Order documentation without complete package from NTIS.. Order Number DE87004031/JAW.

The IEA/ORAU Long-Term Global Energy-Co_2 Model was originally adapted for a main frame environment, with the computer code written in FORTRAN IV. The Carbon Dioxide Information Center (CDIC) packaged the main frame version in 1984. The mainframe version was modified for use on an IBM personal computer (PC). Because of the positive response received at conference and the large number of requests for the PC version, a user's guide was written and the PC version of the model are available from CDIC. Differences between the mainframe version and the PC version are discussed in the user's guide and the pertinent literature provided in this document. The PC version enables the user to modify interactively a total of 39 different major assumptions from 12 categories through the use of an inertial data editor. As in the main frame version, modifications to the data, source code, or other assumptions can still be made with any text editor. The internal data editor provides a way to temporarily change assumptions and to identify default values of the model.

1647 **(ORNL/TM—10777) Comparative sensitivity, mechanisms, and whole plant physiological implications of responses of loblolly pine genotypes to ozone and acid deposition.** McLaughlin, S.B.; Adams, M.B.; Edwards, N.T.; Hanson, P.J.; Layton, P.A.; O'Neill, E.G.; Roy, W.K. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 301p. NTIS, PC A14/MF A01. Order Number DE89001956/JAW.

A quantitative and mechanistic basis for evaluating the potential effects of atmospheric pollutants on physiology and growth of seedlings of loblolly pine, an important timber species in southern commercial forests, was evaluated in laboratory and controlled field studies. Fifty-three half-sib families of loblolly pine were examined. Primary objectives were to (1) quantify differences in growth responses of these 53 half-sib families to the individual and interactive effects of simulated acid rain and ozone in the field, (2) characterize the physiological basis of observed responses in field and laboratory studies, (3) compare and contrast results obtained with similar experimental protocols in field and laboratory approaches, and (4) develop experimental protocols for quantifying physiological and growth responses of large trees in the field. 152 refs., 41 figs., 42 tabs.

1648 **(PB—88-212394/XAB) Review of the US Consumer Product Safety Commission's health effects and exposure assessment documents on nitrogen dioxide. Report of the Clean Air Scientific Advisory Committee. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 9 May 1988. 39p. (SAB/CASAC—86/021). NTIS, PC A03/MF A01.

At the request of the Consumer Product Safety Commission, the Clean Air Scientific Advisory Committee conducted a review on the potential health hazards associated with exposure to 0.1 to 1.0 ppm nitrogen dioxide generated by unvented indoor combustion sources. The committee concluded that: (1) repeated peak exposures at concentrations of 0.3 ppm of nitrogen dioxide may cause health effects in some individuals; (2) the population groups that appear most sensitive to nitrogen dioxide exposure include children, chronic bronchitics, asthmatics, and individuals with emphysema; and (3) the most direct evidence regarding lung damage associated with nitrogen dioxide is obtained from animal studies.

1649 **(PB—88-235288/XAB) Low-level formaldehyde monitor.** Beer, S.Z. (Niagara Scientific, Inc., East Syracuse, NY (USA)). Oct 1985. 32p. NTIS, PC A03/MF A01.

An estimated 1.4 million people are exposed to formaldehyde in the workplace, and virtually the entire poplation comes into contact with the chemical because of its ubiquitous presence in polluted air and in consumer products. An interim report from the Chemical Industry Institute of Toxicology stated that formaldehyde has a synergistic effect on other human-cell mutagens. OSHA has recommended a workplace ceiling limit of 1 ppm. An instrument for the detection of formaldehyde in the ambient atmosphere down to very low levels has been shown here to be feasible. The instrument does not depend on the use of any depletable reagents, and thus can operate unattended for long periods of time. The detectability limit is shown to be lower than 10 ppb.

1650 **(PB—88-235536/XAB) Survey of industrial-hazard anticipation technology. Final report.** Coffey, S.; Yeager, W.; Kulkarni, S. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jul 1988. 57p. (RTI—54). NTIS, PC A04/MF A01.

This report reviews currently available technologies for monitoring the operations of chemical manufacturing and handling facilities to detect airborne emissions of hazardous chemicals before they reach levels that pose an acute hazard to public health. The survey is a first step toward providing industrial planners and plant managers with an overview of available monitoring techniques, which would aid them in designing appropriate warning and safety systems.

1651 **(PB—88-236021/XAB) Implicit normal-mode initialization of the PSU/NCAR (Pennsylvania State University/National Center for Atmospheric Research) mesoscale model. Technical note.** Errico, R.M.; Bates, G.T. (National Center for Atmospheric Research, Boulder, CO (USA). Climate and Global Dynamics Div.). Jun 1988. 124p. NTIS, PC A06/MF A01.

This report describes a contribution to the Pennsylvania State University/NCAR Mesoscale Model. The primary purpose of the contribution is to provide more-realistic initial data for use by that model. The software was designed for use with the Pennsylvania State University/NCAR Mesoscale Model designated MM4, although it is easily adaptable to other models. In addition to its function with initial data, it may be used as a diagnostic tool to investigate the model's behavior. The report replaces an earlier report (Errico, 1986) which had an incorrect linearization of the hydrostatic equation. Effects of that error were minimal regarding nonlinear initialization, but were gross for linear initialization. Differences between the old and new reports are summarized in Appendix 1.

1652 **(PB—88-236229/XAB) Cadmium emissions from primary lead and primary copper smelting: Phase 1. Technical report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jun 1988. 38p. (EPA—450/3-88/006). NTIS, PC A03/MF A01.

Descriptions of these industries and associated air-pollution control equipment are presented. Cadmium-emission estimates for all U.S. plants in these two source categories and health risks from exposure to these emissions from each plant are discussed.

1653 **(PB—88-236237/XAB) Compilation of air-toxics emission inventory questionnaires.** (Engineering-Science, Inc., Cary, NC (USA)). Jun 1988. 207p. NTIS, PC A10/MF A01.

See also PB—86-238086.

To assist States and local agencies, The Environmental Protection Agency (EPA) has developed programs to address the status of the air-toxics problem in their localities. This document provides example questionnaires used by several State and local agencies for collecting emissions inventory data for air toxics. The report also contains discussion of considerations for developing such questionnaires and the elements that are likely to be included.

1654 **(PB—88-236591/XAB) Industrial-hygiene report: perchloroethylene at Dubarry Cleaners, Detroit, Michigan.** Roberts, D.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 18 Jul 1980. 13p. (IWS—71.34). NTIS, PC A03/MF A01.

An on-site visit was made to Dubarry Cleaners, Detroit, Michigan, as part of an industry-wide mortality and industrial hygiene study of dry cleaning workers exposed to perchloroethylene (PCE). Air samples were taken at the facility and the time weighted average exposure to PCE was calculated to be 23 parts per million (ppm) with 5-minute peak exposures ranging from 33 to 141 ppm. A 15-minute sample collected indicated a 34-ppm peak of PCE. The author recommends that prospective employees receive preemployment physical examinations, that all dry-cleaning machines and recovery units be equipped with a unit blower capable of providing an indraft velocity through the loading door of 100 feet per minute for each square foot of door opening, that respiratory protection be provided for emergency use, that protective clothing to prevent skin exposure be provided, that all employees be informed as to hazards, symptoms and precautions to take, that storage containers, equipment, piping, and valves be checked for leaks, and that recovered solvent be piped directly to the base tank of the dry cleaning machine and residues containing solvent be disposed of in a manner which would not create a health hazard.

1655 **(PB—88-236823/XAB) User's guide for the Fugitive Dust Model (FDM). Final report.** Winges, K.D. (TRC Environmental Consultants, Inc., Mountainlake Terrace, WA (USA)). Jun 1988. 107p. NTIS, PC A06/MF A01.

This document provides a technical description and User's Instructions for the Fugitive Dust Model. The FDM is a Gaussian-plume base dispersion model specifically designed for computation of fugitive-dust concentrations and deposition rates. It's chief advantage over other models is an advance deposition algorithm. A validation study has been performed and is included as an appendix. The document also includes sample input and output printouts and a complete listing of the FORTRAN computer code.

1656 **(PB—88-236864/XAB) Health-hazard evaluation report HETA 85-354-1872, Asarco, Denver, Colorado.** Thun, M.J.; Osorio, A.M.; Schober, S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1988. 27p. (HETA—85-354-1872). NTIS, PC A03/MF A01.

An evaluation was made of possible hazardous working conditions at the ASARCO Globe facility, Denver, Colorado. The facility was involved in the recovery of cadmium from baghouse dust, a waste byproduct of nonferrous smelters. A medical study of kidney function was conducted in 45 current or former cadmium production workers; results were compared to those for 35 hospital workers. Kidney abnormalities were more common and more severe in the cadmium workers than in the hospital workers. Abnormalities of proximal tubular function included reduced reabsorption of beta-2-microglobulin, retinol binding protein, calcium and phosphate. Glomerular dysfunction was evidenced as elevated serum creatinine. As length of exposure to cadmium increased, changes became more apparent in workers. No reversal of the conditions was noted in workers who had ceased to be exposed to cadmium some time before the study. The authors conclude that occupational overexposure to cadmium caused kidney disease in workers at the facility.

1657 **(PB—88-236880/XAB) In-depth survey report: design of improved workstations for handling dry chemical powders at B. F. Goodrich Company, Industrial Plastics Division, Marietta, Ohio.** Gressel, M.G.; Fischbach, T.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1988. 39p. (ECTB—169-11). NTIS, PC A03/MF A01.

A study was conducted to redesign a ventilated work station to achieve better control over dust during the weighing out and transferring of powdered materials. The control methods evaluated were booth flows of full, two thirds, and one third (of full flow), the presence of an air shower above the worker, and the presence of local ventilation in the form of a slot hood behind the bulk material drum. Twelve possible combinations of these controls were evaluated. The study indicated that it is possible to design a better ventilated booth by installing additional types of controls.

1658 **(PB—88-236948/XAB) Health-hazard evaluation report HETA 85-274-1879, evaluation of zinc chloride smoke-generating devices, International Association of Fire Fighters, Washington, DC.** Zey, J.N.; Richardson, F. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1988. 48p. (HETA—85-274-1879). NTIS, PC A03/MF A01.

An assessment was made of hazards to fire fighters of using different zinc-chloride smoke generating devices, manufactured by the Superior Signal Company, Inc., New Jersey. used in fire-fighter-training exercises, zinc compounds, hydrochloric acid and over 50 chlorinated hydrocarbons were detected in smoke clouds. The concentration of hydrochloric acid ranged as high as 420 mg/m^3. Zinc chloride concentrations ranged from 11 to 498 mg/m^3. A telephone survey was conducted of 62 different fire fighting training organizations around the United States to obtain information they might have on use of similar devices. A literature search revealed that there had been severe adverse health effects, including death, resulting from exposure to a dense smoke cloud from a zinc-chloride smoke-generating device. Individuals who were adversely affected were not wearing respiratory protective gear or had malfunctioning gear. Symptoms of exposure included sore throat, difficulty breathing, joint pain, chills and fever, headache, and generalized fatigue. The authors conclude that no smoke-generating device should be considered safe and nontoxic, and that measures should be taken to reduce exposures to smoke clouds from such devices. Alternative methods to distort vision in fire-fighting training exercises should be considered.

1659 **(PB—88-237268/XAB) In-depth survey report: control technology for falling solids at Cincinnati Paint and Varnish, Cincinnati, Ohio.** Heitbrink, W.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1988. 28p. (ECTB—154-12B). NTIS, PC A03/MF A01.

A visit was made to the Cincinnati Paint and Varnish Company, Cincinnati, Ohio, to determine the effectiveness of control measures used to contain dust generated during the manufacturing of custom coatings. Dust arose when 50 pound bags of different powdered materials, titanium dioxide, talc, and crystalline silica, were emptied into 600-gallon mixing tanks by a worker. The worker slit the bags with a knife, lifted the bag, poured the contents into the mixer, and returned the empty bags to the floor. Exterior surfaces of the bags were dusty; handling them released some dust into the atmosphere. A slot hood was used to capture dust generated during the operation. Air velocity toward th slot hood along the lip of the tank where the bags were emptied ranged from 50 to 100 feet per minute. The total dust concentrations determined for crystalline silica during this operation averaged 3.0mg/cum. During a revisit to the site this worker's exposure was below 0.15mg/cum for a time-weighted average of less than 0.004 mg/m^3. The difference in liquid level in the tank at the time each powdered ingredient was added may have significantly affected the amount of dust released. Measurements of the actual process indicated that the silica had to fall almost 1 meter before reaching any liquid in the mixing tank whereas the talc had to fall only 25 centimeters.

1660 **(PB—88-237276/XAB) Industrial hygiene walk-through report, Diamond Shamrock Chemical Company, Belle, West Virginia.** Egan, E.; Boeniger, M.; Meinhardt, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). 10 Jun 1976. 17p. (IWS—60.11). NTIS, PC A03/MF A01.

A walk-through survey was conducted at the Diamond Shamrock Chemical Company, Belle, West Virginia, where chloroform, methylene chloride, carbon tetrachloride, and muriatic acid were produced. Raw materials and possible contaminants encountered during the production process included methanol, hydrochloric acid, and catalysts. Personal air samples were taken on a rotating basis routinely for all production and laboratory workers. Periodic physical examinations were required for employees, and protective glasses, shoes, and respirators were supplied by the company. The hazards at this facility included possible chemical burns, damage to the nervous system or liver from methanol exposure,

and a suspected cancer risk from chloroform and carbon tetrachloride exposures. Chloromethane was detected in quantities ranging from 0.04 to 34.7 parts per million (ppm) with one reading reaching 101.7 ppm in the maintenance shop area. Readings for dichloromethane ranged from 0.83 to 30.0 ppm with one reading reaching 43.3 ppm for a reactor operator. Trichloromethane readings ranged from 1.0 to 19.9 ppm with one reading reaching 44.3 ppm for a still operator. Readings for carbon tetrachloride ranged from less than 0.03 to 1.9 ppm with one reading reaching 8.9 ppm for a reactor operator.

1661 **(PB—88-237300/XAB) Health-hazard evaluation report HETA 87-321-1880, Barmet Aluminum Corporation, Livermore, Kentucky.** Hills, B.; Savery, H.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1988. 30p. (HETA—87-321-1880). NTIS, PC A03/MF A01.

A study was made of possible hazardous working conditions at the Barmet Aluminum Corporation, Livermore, Kentucky. Concern was expressed over exposure to aluminum dross dust and ammonia vapors in the dross mill, cast house, and furnace building. Analyses were made of a bulk sample of dross, personal breathing zone air, and area air. Ammonia vapors were present in potentially harmful quantities. Airborne concentrations of total dust, respirable dust, and respirable silica dust exceeded NIOSH recommended exposure limits or OSHA permissible-exposure limits. A self-administered questionnaire was used to investigate symptoms in 12 workers from the dross mill and 12 workers from the rolling mill. Respiratory symptoms were not more common among dross mill workers than rolling mill workers. The authors conclude that workers were exposed to potentially hazardous levels of dust and ammonia vapor. The authors recommend specific measures to reduce dust concentration, control employee exposures to metal fumes, control noise exposures, and inform workers of the hazards of their jobs.

1662 **(PB—88-237326/XAB) Health-hazard evaluation report HETA 87-122-1881, General Dynamics, Airforce Plant No. 19, San Diego, California.** Hartle, R.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1988. 23p. (HETA—87-122-1881). NTIS, PC A03/MF A01.

An evaluation was made of possible hazardous working conditions at the General Dynamics, Airforce Plant Number 19, San Diego, California, including possible exposure to polychlorinated biphenyls (PCBs). The major use for the building was as a storage facility for furniture, fibrous-glass molds, electrical parts, and surplus war materials. Environmental air samples were collected from 11 locations in the building; none showed evidence of detectable PCB concentrations. Surface-wipe samples demonstrated PCB concentrations from nondetectable to 11 micrograms/square meter (microg/m^2). Surface-wipe samples taken from the surface of a leaking transformer indicated concentrations ranging from 1500 to 1600microg/m^2. Blood samples from 30 individuals were analyzed for PCB concentrations and found to be within the limits for a normal nonexposed population. A health hazard from exposure to PCB did not exist at the time of the study. Visibly contaminated areas from the leaking transformer should be reevaluated for the effectiveness of previous cleaning efforts and recleaned to reduce the contamination to an acceptable level.

1663 **(PB—88-237557/XAB) Industrial-hygiene survey of the zinc cell room, anode room, and zinc-casting area, Bunker Hill Company Kellogg, Idaho.** Larson, L.B. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1971. 22p. (IWS—56.10). NTIS, PC A03/MF A01.

A study was begun at the Bunker Hill Company at the request of the state mine inspector to determine possible health hazards to workers at the smelter and zinc refinery located in Kellogg, Idaho. In-depth surveys were conducted of the lead anode room, the cell room, the zinc casting department, and the old roaster building and roaster number 5 building. The facility produced over 300 tons of high-purity zinc per day. At the roasters any sulfur was burned off in the form of sulfer dioxide gas which escaped into the work atmosphere. Large amounts of fumes were emitted from the scrap furnace and the number 2 furnace. Workers in the cell room did not wear any respiratory protection. Considerable dust was noted at the mixer and screening operation. Huge dust accumulations were noted on the ledges of the roaster building, even though the building does have a vacuum system. Workers were also exposed to nitrogen dioxide fumes. Zinc and lead concentrations were measured in the air. At the casting area, zinc oxide fumes were emitted into the work environment with values above 5 mg/cu m being recorded.

1664 **(PB—88-237581/XAB) Health-hazard evaluation report HETA 84-066-1883, Artesian Industries, Mansfield, Ohio.** Crandall, M.S.; Singal, M.; Anastas, M.Y. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1988. 56p. (HETA—84-066-1883). NTIS, PC A04/MF A01.

In response to a request from workers at Artesian Industries, Mansfield, Ohio, an investigation was made of possible hazardous working conditions. Workers were experiencing lightheadedness, shortness of breath, fainting, lung problems, and skin rashes. For 86 air samples taken, respirable crystalline silica personal exposures averaged 0.12 mg/cu m (NIOSH Recommended Exposure Limit (REL) for respirable crystalline silica, 0.05 mg/cu m); 38 of the samples exceeded the REL. All samples from the slip houses exceeded the NIOSH REL. The 18 samples taken in the casting area indicated that the average exposure limit was 0.06 mg/cu m, with eight samples exceeding the NIOSH REL. In the dry-finishing area 18 samples showed an average respirable silica concentration of 0.11 mg/cu m. Exposure to talc averaged 2.7 mg/cu m in the casting areas for 38 samples. Symptoms of chronic cough were noted in 20%, chronic bronchitis in 5%, and shortness of breath in 31% of the workers. Of 196 chest x-rays examined, 18 exhibited evidence of asbestos or talc exposure; five had symptoms of silicosis. The authors conclude that there is a serious, extensive problem regarding exposures to respirable silica and respirable talc dust.

1665 **(PB—88-237664/XAB) Health-hazard evaluation report HETA 85-432-1878, Chevron U.S.A., Inc., Port Arthur, Texas.** Markel, H.L.; Wilcox, T.G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1988. 26p. (HETA—85-432-1878). NTIS, PC A03/MF A01.

In response to a request, an evaluation was made of cancer incidence and possible hazardous conditions at the Chevron U.S.A. Laboratory. The laboratory performs product analyses and tests on environmental samples to satisfy Environmental Protection Agency requirements. Airborne concentrations of toluene, xylene, n-heptane, and n-hexane were all below the recommended OSHA levels. Five breathing-zone samples and one general area air sample exceeded the NIOSH 0.1 part per million recommended exposure limit for benzene. Some laboratory hoods did not meet minimum requirements to maintain contaminant concentrations below exposure limits. Deaths due to all malignant neoplasms were not found to be elevated. There was a statistically significant excess of rectal cancer and three deaths due to hematopoietic disorders.

1666 **(PB—88-237714/XAB) Relationship of clearance and deposition of silica to histological and immunological changes. Master's thesis.** Burns, C.A. (Pennsylvania State Univ., University Park (USA). Center for Air Environment Studies). Mar 1978. 108p. NTIS, PC A06/MF A01.

Inbred female Balb/c-mice were exposed to silica dust over a period of 39 weeks to study alterations of B-lymphocyte immunocompetence. At all time points following the aerosol-stimulation of the mice with whole Escherichia-coli-055:B5, the thymus-independent anti Escherichia-coli lipopolysaccharide (LPS) response was significantly suppressed in the spleen. In the mediastinal lymph nodes (MLN) the immune response to LPS was enhanced at 9 weeks, followed by a depression. When the silicon damaged lungs were bypassed using an intravenous injection of the antigen the response was not noted. Histological examination of silicotic lesions indicated silica laden aggregations or dust cells at 24, 33, 36, and 39 weeks. The presence of silica dust in the lungs was confirmed using energy dispersive x-ray analysis, which also identified submicroscopic silica particles in the spleen. The lungs and MLNs demonstrated granulomatous and fibrotic changes at 39 weeks. Aerosol-immu-

nized lungs demonstrated perivascular and peribronchiolar lymphocytic cuffing. The bronchioles of silica exposed animals contained a greater number of macrophages. Infiltration of macrophages was noted adjacent to blood vessels and respiratory airways on scanning electron microscopy examination.

1667 **(PB—88-237748/XAB) Minerals research progress report No. 2.** Smith, R.M. (Nevada Univ., Reno (USA). Dept. of Chemical and Metallurgical Engineering). Jul 1973. 52p. NTIS, PC A04/MF A01.

This progress report contained seven individual studies. Studies included: the dissolution of asbestos minerals in neutral salt solutions; electrooxidation of cinnabar, and the importance of parameters such as salt concentration, ore particle size, current density, treatment rate in amps per ton ore, electrode composition, electrode spacing, and temperature on the mercury content of the calcine; the use of a new analytical method based on x-ray emission induced by the passage of energetic protons through mineral samples for the performance of trace-metal analyses of asbestos minerals; adsorption of carboxylic groups of ferric-oxide and hematite, in relation to a new class of collectors, the amphoteric surfactants; the correlation between nickel and magnesium dissolution from chrysotile in 1 normal hydrochloric-acid and 1 normal acetic-acid solutions; injection of Swiss-Webster-mice in the flank with amosite suspended in physiological saline to investigate fiber distribution via the lymphatic system; and injection of Wistar rats in the thoracic cavity with asbestos samples to study the carcinogenesis of asbestos fibers as related to surface chemistry.

1668 **(PB—88-237763/XAB) Site-visit report: Reichhold Chemicals, Inc., Tacoma, Washington.** Marlow, D.A.; Fingerhut, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 3 Dec 1985. 36p. (IWS—117.17). NTIS, PC A03/MF A01.

A site visit was made to a pentachlorophenol (PCP) production facility, Reichhold Chemicals Incorporated, Tacoma, Washington, to investigate possible contamination of the PCP with polychlorinated dibenzo-p-dioxins and dibenzofurans. During the production process, PCP fumes and dust occurred at the small shaker screen, the bagger and the molding stations; dust and fumes were vented to a mold bag filter system. A total of 28 personal breathing-zone samples were collected during 2 days of sampling. Two of the samples were above the 0.5mg/m^3 time-weighted average (TWA) permissible exposure limit for PCP. One was 1.65mg/m^3 for an operator who was bagging prilled PCP. This individual wore a respirator so that his exposure was less. A maintenance man recorded a TWA of 0.68mg/m^3, and the author was not using safety equipment. Five bulk samples were also collected. It was not possible to measure dioxins in the personal breathing-zone or area air samples. However, using the concentrations of PCP measured on the filter portion of the personal breathing zone samples, estimates were made for dioxins and furans. The authors conclude that workers at this facility are suitable for inclusion in the Dioxin Registry. The authors recommend that efforts should be undertaken to reduce the amount of dust generated during the PCP bagging operation.

1669 **(PB—88-237912/XAB) Estimating performance and costs of retrofit SO_2 and NOx controls for acid-rain abatement. Report for November 1985-January 1988.** Jones, J.W. (Radian Corp., Research Triangle Park, NC (USA)). Aug 1988. 9p. NTIS, PC A02/MF A01.

This paper gives results from an ongoing National Acid Precipitation Assessment Program (NAPAP) to significantly improve engineering cost estimates currently being used to evaluate the economic effects of applying SO_2 and NOx controls to existing coal-fired utility boilers. Initially, procedures were developed to: select plants with boilers representative of the population, conduct plant visits and collect site-specific data, develop boiler/control-specific retrofit difficulty factors, and develop boiler/plant-specific cost and performance estimates for the SO_2 and NOx controls selected for evaluation. Eleven commercial and developmental SO_2 and NOx control technologies were selected for inclusion in the program. Of 30 top 200 plants selected for detailed study, 12 have been visited. Based on results from these 12 plants, simplified procedures have been developed and used to evaluate about 50 of the remaining top 200 plants.

1670 **(PB—88-238142/XAB) Do functional changes in humans correlate with the airway removal efficiency of ozone.** Gerrity, T.R.; McDonnell, W.F. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Aug 1988. 12p. (EPA—600/D-88/165). NTIS, PC A03/MF A01.

One of the more commonly observed responses to acute exposure to ambient levels of ozone during exercise is a decline in tidal volume and an increase in breathing frequency. It has been hypothesized that the response helps to limit the dose of ozone to the lower respiratory tract. To test the hypothesis, 20 healthy nonsmoking male volunteers were exposed to 0.4 ppm ozone while undergoing continuous exercise. Tidal volume significantly fell by 25% ($p<0.003$) during exposure. At the same time the ozone uptake efficiency of the lower respiratory tract significantly fell by 9% ($p<0.04$). These declines were significantly correlated ($p<0.004$), suggesting that the tidal volume reduction experienced during ozone exposure with exercise helps to limit the amount of ozone delivered to lower respiratory tract tissue.

1671 **(PB—88-238191/XAB) Comparison of the RADM (Regional Acid Deposition Model) dry deposition module with site-specific routines for inferring dry deposition.** Wesely, M.L.; Lesht, B.M. (Argonne National Lab., IL (USA). Biological, Environmental, and Medical Research Div.). Aug 1988. 110p. NTIS, PC A06/MF A01.

The dry-deposition module of the Regional Acid Deposition Model (RADM) is used to compute the dry-deposition velocities (downward flux divided by concentration at a specified height) for SO_2, SO_4(2-), O_3, and HNO_3, among others. With its computerized land-use map, the module can provide estimates of the deposition velocities for a given set of meteorological and surface conditions representative of an area located anywhere in the contiguous United States and nearby locations. As part of the project, the module was modified to accept data on meteorological and surface conditions observed at measurement stations rather than use inputs computed with RADM. The purpose of these modifications was to make site-specific estimates of dry-deposition velocities and compare these with results from the site-specific inferential technique developed at the Atmospheric Turbulence and Diffusion Division of NOAA's Air Resources Laboratory. Goals of the comparisons include estimating the relative uncertainties of the two techniques, suggesting improvements, and examining the ability of the modified module to provide estimates of dry deposition for expanded areas around the measurement sites.

1672 **(PB—88-238340/XAB) Sources of fine-particle organic matter in Boise.** Lewis, C.W.; Dzubay, T.G.; Zweidinger, R.B.; Highsmith, V.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Aug 1988. 10p. (EPA—600/D-88/147). NTIS, PC A02/MF A01.

Ambient concentrations of fine-particle extracted organic matter (EOM) measured at the Elm Grove Park and Fire Station sites in Boise have been apportioned to their two principal sources, wood smoke and motor-vehicle emissions. A multiple linear-regression method using lead and potassium-based tracers for motor vehicles and wood smoke, respectively, was employed in the source apportionment. On average wood smoke was found to be the dominant contributor to EOM at both sites and during both day and night. In spite of the 90% reduction in the lead content of leaded gasoline in the U.S., which has been in effect since January 1986, lead still appears to be a viable tracer of motor-vehicle emissions.

1673 **(PB—88-238464/XAB) Controlling air toxics: an advisory system. Report for May 1987-February 1988.** Nolen, S.; Micai, T.; Shareef, G.; Johnston, M. (Radian Corp., Research Triangle Park, NC (USA)). Jul 1988. 20p. NTIS, PC A03/MF A01.

This paper discusses the development and use of a computerized advisory system for the control of air toxics. The program, is written for the IBM PC using Microsoft C V3.0 compiler and Windows for Data Library V1.0 for screen and keyboard interaction. The permit reviewer inputs information on the air-emission-stream characteristics as well as other information in the permit applica-

tion. The program allows the permit reviewer to select a specific pollution control device for evaluation. The program then calculates design parameters and estimates costs for each control technology selected. The results can be compared against the applicant's actual or proposed design. The program is designed to easily allow what-if calculations, allowing the reviewer to change one or more parameters and recalculate the results. A report generator is included in the program.

1674 **(PB—88-238472/XAB) Project PEPE-NEROS (Persistent Elevated Pollution Episodes-North East Regional Oxidant Study) (1980): description of the data base. Final report.** Gillani, N.B. (Washington Univ., St. Louis, MO (USA)). Aug 1988. 138p. NTIS, PC A07/MF A01.

Project PEPE-NEROS was a major EPA-sponsored field-measurements program conducted during the summer of 1980 out of Columbus, Ohio. The dual objectives were to create data bases for (a) the study of the evolution and composition of regional haze episodes occurring in northeastern U.S., particularly during summer months, and (b) the study of oxidant formation and transport in urban plumes and on regional scale. Many research groups representing EPA, NASA and other government agencies, as well as industry and universities participated in the field study. The overall data base of PEPE-NEROS was centralized and standardized at Washington University. The two-part report describes and documents the data base and its availability. Part I overviews the measurements and the data base, and lists the many reports which contain details of the measurement platforms and their missions. Part II gives documentation of the final General Distribution Data Base of PEPE-NEROS which is contained on two magnetic tapes.

1675 **(PB—88-238936/XAB) Distribution of volatile organic hydrocarbons and aldehydes during the IACP (Integrated Air Cancer Project) Boise, Idaho residential study. Final report.** Zweidinger, R.; Tejada, S.; Highsmith, R.; Westburg, H.; Gage, L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Aug 1988. 11p. (EPA—600/D-88/148). NTIS, PC A03/MF A01.

The U.S. EPA's Integrated Air Cancer Project (IACP) conducted a field study in Boise, Idaho during November 1986 - February 1987. As part of the study, samples were collected in ten pairs of homes, one with and one without a wood-burning appliance. Paired homes were located near each other and concurrent sampling was conducted inside each home and outside the home not burning wood. A different pair of homes was sampled each week during the study. Averaged data from all homes showed total non-methane organic carbon (NMOC) and total carbonyls to be higher inside either home type relative to outside. Average formaldehyde concentrations were slightly higher inside homes with woodstoves, but several non-wood-burning homes had concentrations exceeding many of the wood-burning homes. Benzene concentrations inside homes seemed related to mobile sources and were similar to outdoor levels.

1676 **(PB—88-239009/XAB) Annular denuder results from Boise, ID.** Stevens, R.K.; Dzubay, T.G.; Baumgardner, R.; Zweidinger, R.; Highsmith, R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Aug 1988. 13p. (EPA—600/D-88/168). NTIS, PC A03/MF A01.

Samples from annular denuder systems (ADS) collected during the winter of 1985-1986 in Boise, ID, were analyzed for acidic oxides of nitrogen and sulfur. The correlations between the data from the ADS and XRF measurements of Pb and K in the fine particles were examined to determine if any of the species collected by the ADS (e.g., HNO_2, HNO_3) would serve as receptor-modeling tracers for the extractable organic matter (EOM) from mobile and/or wood-burning sources. Results of these correlations are discussed. The report also discusses the precision of the ADS measurements and compares results obtained with other measuring methods for similar species (e.g., XRF data for S with sulfate measured with the ADS). In addition, comparison of ambient concentrations of species measured with the ADS at the two monitoring sites in Boise are examined in relationship to the chemical properties of fine particles collected in Boise, ID and spatial homogeneity of gases and aerosols.

1677 **(PB—88-239041/XAB) Comparison of EPA (Environmental Protection Agency) test house data with predictions of an indoor-air-quality model.** Sparks, L.E.; Jackson, M.D.; Tichenor, B.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Jul 1988. 20p. (EPA—600/D-88/163). NTIS, PC A03/MF A01.

An easy-to-use indoor-air-quality (IAQ) model is described. It is multi-compartmented and based on a well-mixed mixing model. Sources and sinks are allowed in each compartment. A menu-driven fill-in-the-form user interface controls program flow and is used to obtain data from the user. On-screen graphical output is provided. The model estimates the effects of heating, ventilation, and air conditioning (HVAC), air cleaning, room-to-room air movement, and natural ventilation on pollutant concentrations. Experiments conducted in the EPA test house using moth crystal cakes for model verification are described. The agreement between small chamber emission factors, model predictions, and test house data is very good. Predicted weight loss of the moth crystal cakes was within 5% of the measured weight loss. Predicted room concentrations of p-dichlorobenzene are within 20% of the measured values. Future directions for model development and experimental studies are discussed.

1678 **(PB—88-239058/XAB) Research in a regulatory environment.** Drehmel, D.C.; Princiotta, F.T. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Aug 1988. 13p. (EPA—600/D-88/173). NTIS, PC A03/MF A01.

This paper discusses the rationale and motivation for integrated environmental control as it relates to EPA research, particularly as it involves risk management. EPA research, whether in support of integrated environmental control or not, must be responsive to the Agency's regulatory function. Risk-reduction programs have been successful in the past, leading to demonstration of fluegas desulfurization (FGD) and low nitrogen oxide (NOx) burner technologies. One emphasis of current risk-reduction research activities is integrated environmental control because of the possibility of greater cost effectiveness. Two examples of integrated environmental control are described: limestone injection multistage burners (LIMB) and electrostatic precipitators-sulfur oxides (E-SOx). Both technologies show great promise for moderate to high SO_2 control with very low cost and ease of retrofit.

1679 **(PB—88-239124/XAB) Multimedia, multipollutant field study to establish levels of toxic contaminants in air, soil, sediment, water, and agricultural products from a model municipal-waste combustor.** Fradkin, L.; Hartlage, T.; Watts, R.; Harless, R.; Walling, J.F. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Aug 1988. 14p. (EPA—600/D-88/155). NTIS, PC A03/MF A01.

In the past, assessments have been directed only at the public-health risks posed by stack and fugitive emissions of pollutants from municipal-waste combustors (MWCs) by direct inhalation exposure. Recently, the U.S. EPA has developed methodologies to extend risk assessment to a consideration of indirect exposure pathways in addition to the direct inhalation pathway. A better understanding of the multipollutant and multiple-exposure pathways of emissions from waste combustors is needed in order to improve the overall assessment of the risks to humans and the environment. This study provides a preliminary determination of the overall risks associated with MWCs. As part of the overall approach, a field evaluation of a MWC was selected in Rutland, Vermont. During a one-year period, a four-station ambient-air-monitoring network for pollutants will be operated by the State of Vermont. The purpose of the monitoring is to ensure that the pollution controls and regulatory requirements imposed on the facility are sufficient to prevent adverse impacts on human health or the environment.

1680 **(PB—88-239157/XAB) Development and evaluation of the regional oxidant model for the northeastern United States.** Schere, K.L.; Wayland, R.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Aug 1988. 14p. (EPA—600/D-88/169). NTIS, PC A03/MF A01.

This is a second-generation operational Regional Oxidant Model (ROM2) that continues to be developed, tested, and refined. The model is primarily designed for use in evaluating the effectiveness of various emission-control strategies on the regional scale. The purpose of the paper is to provide a brief overview of the ROM2 and to describe the first phase of a model-evaluation study using data from the Northeast U.S.

1681 **(PB—88-240494/XAB) Bacterial emissions from incineration of hospital waste. Final report.** Allen, R.J.; Brenniman, G.R.; Logue, R.R.; Strand, V.A. (Illinois Univ., Chicago (USA). School of Public Health). Jul 1988. 57p. NTIS, PC A04/MF A01.

This research examined the emissions from a hospital incinerator to determine if human pathogenic bacteria were being released into community air. Incineration of the hospital waste resulted in stack gas with excessively high particulate matter and hydrochloric acid which made sampling impossible. Incineration of a substitute waste consisting of paper products, water, and cultures of Bacillus subtilis (a spore producing bacteria) resulted in no viable Bacillus subtilis in the stack-gas samples. Eight bacteria species other than Bacillus subtilis were found in stack gas samples. The indoor air was similar to the stack gas in bacteria number and species composition. It was concluded that these bacteria were able to pass through the incinerator via excess air entering the secondary combustion chamber. One human pathogen (Staphylococcus aureus) was found in the indoor air samples and elevated levels of bacteria were found in hospital hallways adjacent to the incinerator where waste handling occurred.

1682 **(PB—88-244264/XAB) Review of Pollution Control Technology Research and Development: Private-sector Incentives and the Federal Role in the Current Regulatory System. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). Oct 1985. 10p. (SAB/EEC—86/013). NTIS, PC A02/MF A01.

The review was a part of a continuing series of interactions between the Director of Office of Environmental Engineering and Technology (OEET) and the Committee, and reflects the Committee's continuing interest in the technology R and D program in EPA. The objectives of the ICF report were: (1) to develop a conceptual framework which can be used to determine what amount of pollution control technology R and D is optimal from society's perspective; (2) to identify any types of pollution control technology R and D which are not being carried out to a sufficient degree by the private sector in the current regulatory system; (3) to proposed ways that EPA can encourage or work to ensure that more of that R and D is done.

1683 **(PB—88-245741/XAB) Fired heaters: nitrogen oxides emissions and controls. Final report.** Shareef, S.A.; Anderson, C.L.; Keller, L.E. (Radian Corp., Research Triangle Park, NC (USA)). Aug 1988. 156p. (DCN—88-239-004-13-01). NTIS, PC A08/MF A01.

This report gives results of a study of nitrogen oxide (NOx) emissions from, and controls for, fired heaters. The petroleum-refining and chemical manufacturing industries account for most of fired-heater energy use with an estimated 4600 fired heaters in operation, in these two industries. The report gives a brief description of the design and operation of fired heaters. Descriptions of the two major industries with fired heaters and the various heater applications are presented. An estimate is made of the growth in fired-heater energy demand and the number of new fired heaters to be built in the next 5 years in these industries. The factors affecting NOx emissions from fired heaters are discussed, and quantitative relationships are presented, where available. Combustion modifications and flue-gas treatment controls for NOx emissions are described. Low excess air (LEA) operation and low-NOx burners are discussed in detail. Long-term continuous NOx emissions data for 12 petroleum-refinery heaters are presented. Results of a regression model to predict the effect of stack oxygen level on NOx emissions are used to evaluate LEA performance. The study also presents capital and annualized costs for LEA and low-NOx burner controls.

1684 **(PB—88-868179/XAB) Carbon dioxide and climate. January 1970-August 1988 (Citations from the NTIS data base). Report for January 1970-August 1988.** (National Technical Information Service, Springfield, VA (USA)). Aug 1988. 165p. NTIS PC N01/MF N01.

Supersedes PB—86-866563.

This bibliography contains citations concerning the relationship between changes in carbon dioxide in the atmosphere and changes in the climate. Topics include the greenhouse effect, global climatic models, and climatic effects from combustion of fossil fuels. (This updated bibliography contains 254 citations, 75 of which are new entries to the previous edition.)

1685 **(PB—88-868187/XAB) Toxicology of dyes used in the textile industry. January 1975-August 1988 (Citations from World Textile Abstracts). Report for January 1975-August 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 68p. NTIS PC N01/MF N01.

Supersedes PB—87-864229.

This bibliography contains citations concerning the health hazards of dyes used in the textile industry. Safety measures for dye handling, storage, and application are discussed. Toxicology of vapor and dust from dyes is examined, and suggestions for safe, effective ventilation are made. Studies concerning mutations and cancers caused by dyes are briefly cited, and the scarcity of research in this area is noted. The trend towards increased regulations to control the health and environmental impact of dyes is examined. Effluent treatment of dyes is discussed in another bibliography. (This updated bibliography contains 149 citations, 11 of which are new entries to the previous edition.)

1686 **(PB—88-868468/XAB) Carbon dioxide and climate. January 1970-August 1988 (Citations from Pollution Abstracts). Report for January 1970-August 1988.** (National Technical Information Service, Springfield, VA (USA)). Aug 1988. 76p. NTIS PC N01/MF N01.

Supersedes PB—84-872449.

This bibliography contains citations concerning research, observations, and analyses of the relationship between changes in carbon dioxide in the atmosphere and changes in the climate. Topics include the greenhouse effect, global climatic models, and climatic effects from combustion of fossil fuels. Monitoring of carbon dioxide is reported for global observations and special polar-region observations. Some studies relate to identifying anthropogenic causes of the variations from those due to natural sources, such as plants and the ocean reservoir. (This updated bibliography contains 92 citations, 20 of which are new entries to the previous edition.)

1687 **(PB—88-868914/XAB) Pollution effects of beryllium and beryllium compounds. January 1970-September 1988 (Citations from the NTIS data base). Report for January 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 181p. NTIS PC N01/MF N01.

Supersedes PB—87-862546.

This bibliography contains citations concerning sources and abatement measures used to control pollution caused by beryllium and beryllium compounds. Topics include exposure standards characterization, toxological studies, monitoring programs, and analytical procedures employed in detection and sampling operations. Considerable attention is given to coal combustion and conversion processes as sources of beryllium contaminants. (This updated bibliography contains 262 citations, 19 of which are new entries to the previous edition.)

1688 **(PNL—6500-Pt.1, pp 7-8) Benefit-cost analysis of OHER research.** Nesse, R.J. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

This research was undertaken to estimate societal benefits and costs of selected past research performed for OHER. Three case studies of representative OHER and DOE research were performed. One of these, the acid rain case study, included research conducted in another office in DOE. The other two cases were the OHER marine research program and the OHER project that developed high-purity germanium used in radiation detectors. The acid rain case study looked at research benefits and costs of furnace sorbent injection and duct injection, technologies that might reduce acid deposition precursors. Both appeared to show benefits in excess of costs. They examined in detail one of the marine research program's accomplishments, the increase in environmental information used by the Outer Continental Shelf leasing program to manage bidding for off-shore oil drilling. The results of an econometric model showed that, environmentally, marine research supported by OHER is unequivocally linked to government and industry leasing decisions. Finally, the germanium case study indicated that benefits of germanium radiation detectors were significant.

1689 **(PNL-SA—16139) Ozone measurement using the Chappuis band in the visible spectral region.** LeBaron, B.A.; Michalsky, J.J. (Pacific Northwest Lab., Richland, WA (USA); State Univ. of New York, Albany (USA). Atmospheric Sciences Research Center). Aug 1988. Contract AC06-76RL01830. 12p. (CONF-8808125—2). NTIS, PC A03/MF A01. Order Number DE88015940/JAW.

From International radiation symposium; Lille, France (18 Aug 1988).

Our goal in this paper is to investigate methods of estimating total column ozone abundance using the Chappuis band especially in the presence of a severe perturbation to the stratospheric aerosol layer. 9 refs., 4 figs.

1690 **(PNL-SA—16278) The ten-year pattern (1978-1987) of stratospheric aerosol loading using ground-based radiometry.** Michalsky, J.J.; Pearson, E.W.; LeBaron, B.A. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 15p. (CONF-8808125—3). NTIS, PC A03/MF A01. Order Number DE89001706/JAW.

From International radiation symposium; Lille, France (18 Aug 1988).

In this paper the procedures used to obtain a stratospheric measurement with ground-based sun radiometry are reviewed briefly. The five-wavelength optical depths are then used to study the evolution of aerosol size during the decade. The time history of loading from the instruments described are compared. Particular emphasis will be placed on the Garmisch-Partenkirchen data because their latitude is very nearly that of the PNL site. The most useful data for this study are those observational records that measure total stratospheric aerosol burden and include the early period and continue throughout the eruption and decay of El Chichon. The lidar data from Langley Research Center and Fraunhofer-Institute for Atmospheric Environmental Research at Garmisch-Partenkirchen, the SAM II satellite data, and the Pacific Northwest Laboratory (PNL) sun radiometry are the published contiguous measurements of the stratosphere aerosol burden during this period. 16 refs., 6 figs.

1691 (SERI/CP—231-3355, pp 197-208) **High temperature chemical and thermal stability of chlorinated benzenes.** Tsang, W. (National Bureau of Standards, Gaithersburg, MD (USA)). Jul 1988. NTIS, PC A13/MF A01. Order Number DE88001187/JAW. (CONF-8806176—).

From Thermochemical conversion program review meeting; Golden, CO, USA (21 Jun 1988).

The mechanisms for the destruction of chlorinated benzenes in the high temperature environment of an incinerator are described. Special attention is paid to the importance of pyrolytic processes. The role of hydrogen atom induced displacement of chlorine from the chlorobenzenes is emphasized. Recent measurements on the rate constants for these processes are described. In combination with computer simulations, they may to a definition of the conditions necessary to effect destruction chlorinated aromatics during incineration as well as suggest a proper measurement methodology to verify incinerator operation. 23 references.

1692 **(SNV—3280) Discharge measurements by woodburning in stoves and combi boilers.** Bernergaard, L.; Hindrum, K. (National Swedish Environmental Protection Board, Solna). Dec 1986. 38p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755074/JAW.

In this report results are given from three investigations on emissions from stoves and boilers. In the first investigation the emissions of char (condensible organics) and particulates from a stove were measured by five different laboratories during four tests. The results show that the coefficient of variation for reproducibility is approximately 30%, independent of measured value for char. The results also show that there are very small amounts of char in the particulates and that the dominating part of char is in the gas phase. In the second investigation six repeated tests of a stove were made with continuous measurement of hydrocarbons and carbon monoxide. Three char tests were also made, of which two included a cold start. The correlation between hydrocarbons and carbon monoxide is low for the complete tests. In the initial phase of each fuel cycle there is a good correlation for most of the fuel cycles, but in some cases the correlation is low. Char has a high correlation to hydrocarbons and carbon monoxide, but only three char measurements were made, so these correlations are uncertain. In the third investigation six repeated tests of a boiler were made with continuous measurement of hydrocarbons and carbon monoxide. Char was measured in all six tests. The correlation between hydrocarbons and char is high for these six tests. There is no correlation between carbon monoxide and char, and also no correlation between carbon monoxide and hydrocarbons. The coefficient of variation for repeatability for the char measurements is high, 80-110%. The main reason for this is that the burning conditions for the boiler fluctuates from test to test because of irregular supply of fuel. (authors).

1693 **(STEV-FBT—88-18) Mercury separation in filter ashes (II).** Schager, P.; Lindqvist, O.; Ljungstroem, E.; Hall, B. (Chalmers Tekniska Hoegskola, Goeteborg (SE). Inst. f oorganisk kemi). (Statens Energiverk, Stockholm (Sweden)). 1988. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755086/JAW.

The effect of traces of SO/sub 2/, HCl, NO/sub 2/ and Cl/sub 2/ and combinations of these gases on the oxidation of mercury has been studied in a flue gas generating combustor. The reaction of Hg/sup o/(g) in the presence of O/sub 2/ is fast at high temperature and 10% is oxidized after only 0.8 s. Another 10% is oxidized after 3 s when the temperature has decreased to 175 degrees C. The addition of HCl or Cl/sub 2/ increased the oxidation of Hg/sup o/(g) further: about 50% is oxidized after 0.8 s. The mercury content in the flue gas measured along the flue gas channel decreases as the HCl concentration increases. Traces of SO/sub 2/ seem not to have any reproducable influence on the oxidation of Hg/sup o/(g) though there might occur a reduction of HgO(g) to Hg/sup o/(g) by SO/sub 2/. The addition of NO/sub 2/ has a small but significant effect. In combination with SO/sub 2/ and NO/sub 2/ the influence of HCl is dominating. Solid particles of Ca-compounds have also been added to the flue gas together with traces of HCl or SO/sub 2/. The total amount of Hg (Hg(tot)) as well as the Hg/sup o/(g) content is decreased by addition of Ca(OH)/sub 2/ and to a lesser degree also by CaCO/sub 3/. A minor effect is observed for CaSO/sub 4/. It is likely that this is a function of the surface area of formed CaO. At least 80% of Ca(OH)/sub 2/ is converted to CaO at prevailing conditions, while the corresponding values for CaCO/sub 3/ and CaSO/sub 4/ is 60% and 5% respectively. SO/sub 2/ and HCl in the flue gas cause a reduction of the Hg-adsorption. (authors).

1694 (UBA-FB—86-097) Investigations on corrosion and weathering of asbestos cement products (ACP) as well as on the carcinogenic effect of the weathering products. Spurny, K.R.; Marfels, H.; Pott, F.; Muhle, H. (Umweltbundesamt, Berlin (Germany, F.R.); Fraunhofer-Institut fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.); Fraunhofer-Institut fuer Toxikologie und Aerosolforschung (ITA), Hannover (Germany, F.R.)). Apr 1988. 180p. (In German). Umweltbundesamt, Berlin (Germany, F.R.).

Umweltbundesamt - Texte.; no. 12/88.

A method and an equipment have been developed and used for measurement of fiber emissions from corroded and weathered ACP. Emissions of fibrous dusts were measured on buildings with different types of AC-plates (roofing and facade shingles). The measured emission factors for asbestos fibers longer than 5 μm were in the range of 10/sup 6/ to 10/sup 8/ fibers/m/sup 2/. They depended on the type of the AC-plates as well as on their age and corrosion intensity. The measured concentrations of asbestos fibers (longer than 5 μm) in ambient air in the vicinity of ACP were in the range of 50 to 1000 fibers/m/sup 3/. It could be shown in animal experiments that the carcinogenic potency of 'corroded' asbestos fibers did not differ from the carcinogenicity of 'normal' standard chrysotil fibers. (orig.) With 27 figs., 25 tabs., 97 refs.

1695 (UBA-FB—87-065) Flux measurements of air pollutants along selected sections of the borders (aircraft measurements). Final report. Blommers, A.H.; Lelieveld, J.; Jansen, F.W. (Umweltbundesamt, Berlin (Germany, F.R.)). Jun 1987. 50p. (In German). Umweltbundesamt, Berlin (Germany, F.R.).

This paper reports about the results of aircraft measurements which were performed from May 1985 to March 1987 along selected sections of the frontiers between the Federal Republic of Germany (FRG) an its neighbours. The goal of the measurement flights was the assessment of imports and exports of a number of gas- and solid phase air pollutants. In total 45 measurement flights were carried out. Emphasis was placed on the calculation of transboundary transports across the western and eastern border of the FRG. The main components measured were SO/sub 2/, NO/sub x/, O/sub 3/ sulfate and nitrate. (orig.) With 16 refs., 8 tabs.; 18 figs.

1696 (UCRL—99361) Sensitivity study of global ozone to NO/sub x/ emission from aircraft. Kinnison, D.; Johnston, H.; Wuebbles, D.J. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 5p. (CONF-8808102—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88015433/JAW.

From International Quadrennial ozone symposium; Gottingen, F.R. Germany (8 Aug 1988).

There recently has been renewed interest in the development of faster and more efficient aircraft for intercontinental passenger flights. Such aircraft would probably spend a large fraction of their flight time in the stratosphere, perhaps as high as 35 km. As a natural progression from studies that were done in the early 1970s, this study reinvestigates the sensitivity of stratospheric ozone to NO/sub x/ emissions based on current understanding of atmospheric chemical and physical processes. The LLNL one-dimensional and new two-dimensional chemical-radiative-transport models of the troposphere and stratosphere are used in this investigation. The two-dimensional model provides latitudinal, altitudinal, and seasonal resolution; and the computationally faster one-dimensional model is used for sensitivity studies. Because of uncertainties in possible future emissions, it is necessary to examine the model sensitivity to a wide range in magnitude, altitude, and latitude of assumed NO/sub x/ emissions. As an initial study, the models are used in simulation of a typical scenario from the CIAP era, and results are compared with those of a published two-dimensional model, which includes some three- dimensional features. This investigation lays the groundwork for future studies, including different background amounts of ClX and for other aircraft emission scenarios. 12 refs., 3 figs., 1 tab.

1697 Process for removal of hydrogen halides or halogens from incinerator gas. Huang, H.S.; Sather, N.F. US Patent Application 6-087,835. 21 Aug 1987. 12p. Contract W-31109-ENG-38. NTIS, PC A03/MF A01.

A process for reducing the amount of halogens and halogen acids in high temperature combustion gas and through their removal, the formation of halogenated organics at lower temperatures, with the reduction being carried out electrochemically by contacting the combustion gas with the negative electrode of an electrochemical cell and with the halogen and/or halogen acid being recovered at the positive electrode.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 166, 619, 717, 1610, 1709, 1825

1698 (AD-A—196233/1/XAB) Aerosol charge distributions produced by radioactive ionizers. Hoppel, W.A.; Frick, G.M. (Naval Research Lab., Washington, DC (USA)). 18 May 1988. 42p. (NRL—9108). NTIS, PC A03/MF A01.

This report is an analysis of the physical mechanisms that control the aerosol charge distribution established by radioactive neutralizers. Theoretical calculations and modeling is supplemented by experimental findings obtained with both commercially available ionizers of the authors own design.

1699 (ORNL/M—533) Environmental surveillance data report for the second quarter of 1988. Blasing, T.J.; Daniels, K.L.; Horwedel, B.M.; McCollough, I.L.; Osborne-Lee, A.E.; Valentine, C.L.; Wolf, D.A. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 96p. NTIS, PC A05/MF A01. Order Number DE89002375/JAW.

During the second quarter of 1988, over 1600 samples which represent more than 5000 analyses and measurements were collected by the Environmental Monitoring and Compliance (EMC) Section. A network of real-time monitoring stations which telemeter 10-minute averaged readings of radiation levels, total precipitation, flows, water quality parameters, and air quality parameters around ORNL also reported data. In addition, three meteorological towers sent weather data at various heights to a host computer every 15-minutes. Increases in thorium and uranium isotopes were reported in several of the composited air filters from individual stations during the second quarter. Construction activities, in particular dirt movement, near these sites combined with an unusually dry summer appear to be responsible for most of these increases. There was also an increase in strontium at the sites near the Y-12 plant where the construction activities mainly involve the replacement of New Hope Pond. Elevated levels of these isotopes at individual stations may be expected to continue into the third quarter of 1988 as construction activities continue to cause elevated levels of dust in the air around particular monitoring sites. Real-time measurements of external gamma radiation are now being reported from fifteen stations, including some recently activated or upgraded stations. Measurements this quarter indicate that external gamma radiation around ONRL is close to background, except at station 4 which is located between the Waste Treatment Plant and waste treatment ponds and therefore experiences higher levels of radiation. 1 ref., 16 figs., 46 tabs.

1700 (PB—88-245485/XAB) Review of the agency's radon-mitigation research plan. Final report. (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 12 Jan 1987. 17p. (SAB/RAC—87/016). NTIS, PC A03/MF A01.

The Office of Environmental Engineering and Technology (OEET) briefed the Committee on its draft radon-mitigation test matrix, which is described as the conceptual framework for a project design within a research plan still under development. The OEET asked the Committee to address the following question: Does the basic approach for the development of the matrix appear reasonable. The Committee reviewed the document and made the following conclusions and recommendations: (1) the general approach is reasonable; (2) the number of cells in the matrix should be reduced by combining techniques which have similar effects; (3) increased attention should be given to pre- and post-mitigation measurements; and (4) there is a need for greater emphasis on mitigation for new construction.

1701 **(PB—88-868880/XAB) Radon detection and measurement. January 1970-September 1988 (Citations from the COMPENDEX data base). Report for January 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 135p. NTIS PC N01/MF N01.

Supersedes PB—87-866083.

This bibliography contains citations concerning the measurement of radon and radon-daughter isotopes in various environments. Radon measurement in homes and buildings, mines, rainwater, groundwater, soils, in the Arctic and other atmosphere, and in exhaled air is discussed. Radon exhalation rates of building materials and mine tailings are noted. Analytic methods and equipment used to measure radon and radon isotopes are described. Radon detection as an earthquake prediction tool is briefly presented. (This updated bibliography contains 271 citations, 37 of which are new entries to the previous edition.)

1702 **(PNL-SA—15817) Estimating uncertainties in release rate predictions using downwind exposure measurements: A probabalistic approach.** Geldart, R.W.; Ramsdell, J.V.; Laws, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 5p. (CONF-880913—5). NTIS, PC A02/MF A01. Order Number DE89001729/JAW.

From ANS topical meeting on emergency response: planning, technologies and implementations; Charleston, SC, USA (26 Sep 1988).

In the event of an unmonitored release of radioactive effluents, atmospheric monitoring may provide the only data available for use in estimating the magnitude of the release. This paper describes procedures for using monitoring data to estimate the magnitude of a release and describes the uncertainty in that estimate. The Gaussian plume model is assumed to relate measured concentrations or exposures (time-integrated concentrations) to the magnitude of the source term. The sources of uncertainty considered include the number and types of measurements, random variability of diffusion parameters, and inadequacies in the Gaussian model.

1703 (STUK-A—55, pp 11-15) **Radionuclides in ground-level air. Chapter 1.** Sinkko, K. Jun 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780019/JAW.

In Studies on environmental radioactivity in Finland in 1986. Annual report.

In the air surveillance programme the concentrations of artificial radionuclides are monitored in the air close to the ground to obtain the necessary basic data for estimating the exposure of the Finnish population to fall-out radionuclides and also to detect atmospheric traces of radioactive materials caused by their use or production. Airborne dust is collected on filters with high-volume air samplers and the concentrations of gamma-emitting radionuclides in the air are evaluated. In the first quarter of 1986 only long-lived cesium, caused by earlier atmospheric nuclear explosions was detected. The concetrations of cesium were very low. In January and March a small amount of short-lived, fresh fission and activation products were also observed.

1704 **(STUK-A—55) Studies on environmental radioactivity in Finland in 1986. Annual report.** (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Jun 1987. Vp. NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780019/JAW.

Individual papers in scope for data base are processed separately.

1705 **(UCRL—99502) The environmental effects of nuclear war.** MacCracken, M.C. (Lawrence Livermore National Lab., CA (USA)). Sep 1988. Contract W-7405-ENG-48. 20p. (CONF-8804202—1). NTIS, PC A03/MF A01. Order Number DE89001292/JAW.

From Nuclear arms technologies in the 1990's; Washington, DC, USA (16 Apr 1988).

Substantial environmental disruption will significantly add to the disastrous consequences caused by the direct thermal, blast, and radiological effects brought on by a major nuclear war. Local fallout could cover several percent of the Northern Hemisphere with potentially lethal doses. Smoke from post-nuclear fires could darken the skies and induce temperature decreases of tens of degrees in continental interiors. Stratospheric ozone could be significantly reduced due to nitric oxide injections and smoke-induced circulation changes. The environmental effects spread the consequences of a nuclear war to the world population, adding to the potentially large disruptive effects a further reason to avoid such a catastrophe. 27 refs., 4 figs.

1706 **Examination of the uncertainty in air concentration predictions using Hanford field data.** Miller, C.W.; Fields, D.E.; Cotter, S.J. (Oak Ridge National Lab., TN (USA)). *Health Physics;* **55**: No. 2, 443-450(Aug 1988).

The accuracy of an environmental transport model is best determined by comparing model predictions with environmental measurements made under conditions similar to those assumed by the model, a process commonly referred to as model validation. Over the past several years, we have done a variety of validation studies with the popular Gaussian plume atmospheric dispersion model using data from tests conducted on the Hanford site. Data for short-term releases of small particles for a range of release heights from surface level to 111 m have been used. Downwind distances examined have ranged from a few hundred meters to 12.8 km, depending on the particular data used. Measured and predicted ground-level centerline, crosswind-integrated, and 22.5 degrees sector-averaged air concentrations have been compared. Up to six different sets of atmospheric dispersion parameters and three different atmospheric stability class specification schemes have been examined. Overall, dispersion parameters based on measurements made near Juelich, Federal Republic of Germany, give the best comparisons between observed and predicted air concentrations. The commonly used vertical temperature gradient method for determining atmospheric stability class consistently gives poor results. The accuracy of air concentration predictions improves when dry deposition processes are included in the model. Further validation studies using various Hanford data sets are planned.

1707 **Radon in air calibration procedure: A primary method.** Lucas, H.F.; Markun, F. (Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL (US)). *Nuclear Science and Engineering;* **99**: No. 1, 82-87(May 1988).

A procedure has been developed for preparing 3- to 9-iota volumes of air under natural conditions with a known concentration of /sup 222/Rn to be used for calibrating radon systems. Air is passed into a plastic bag through a standard /sup 226/Ra solution (prepared by the U.S. National Bureau of Standards) contained in an emanation flask. This plastic bag retains /sup 222/Rn with little loss into or through the bag walls. The mean ratios of the /sup 222/Rn in the air at 2 and 7 days after filling to that immediately after filling were .992 +- 0.006 and 0.969 +- 0.008, which suggests a rate of radon loss into the bag of 0.4 +- 0.1%/day.

1708 **Environmental radioactivity. Third edition.** Eisenbud, M. Orlando, FL; Academic Press, Inc. (1987). 475p. Academic Press, Inc., 6277 Sea Harbor Dr., Orlando, FL 32821 $55.00.

From review by D.C. Adriano, Savannah River Ecology Lab., in J. Environ. Qual., Vol. 17, No. 1 (1988).

This book highlights the sources, emission, behavior, and biological and ecological effects of radioactivity from both natural and anthropogenic sources. The emphasis is on the environmental aspects of radionuclides and their eventual effects on biota, particularly humans. Major nuclear accidents are enumerated. The book concludes with a discussion of occupational and general population exposure including estimates for per capita radiation dose from all sources. The author recommends this volume as a premiere source of information in this area.

5005 Site Resource And Use Studies

1709 **(DOE/NV/10327—39) Onsite environmental report for the Nevada Test Site, January 1987-December 1987.** Gonzalez, D.A. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA). Environmental Sciences Dept.). Aug 1988. Contract AC08-84NV10327. 193p. NTIS, PC A09/MF A01. Order Number DE89002156/JAW.

This report documents environmental monitoring at the Nevada Test Site (NTS) as conducted by the Department of Energy (DOE) onsite radiological safety contractor from January 1987 through December 1987. It presents results and evaluations of radiological and non-radiological measurements in air and water, and of direct gamma radiation exposure rates. The radiological monitoring results for CY-1987 reveal that the concentrations of radionuclides in air and water on the Nevada Test Site were low compared to DOE guidelines. The highest average gross beta concentration in air was 0.006 percent of the DOE concentration guide (CG). This concentration is considered close to background for the NTS. The highest average ^{239}Pu concentration in air was 28.5 percent of the CG. The highest average tritium concentration was 0.22 percent of the CG. ^{85}Kr concentrations compared favorably to the offsite average and to worldwide concentrations. All ^{133}Xe positive results were associated with specific events. The highest average gross beta concentration in potable water was well within the allowed CG. Tritium and ^{239}Pu levels were below detection levels and consequently below CG's. Contaminated waters contained measurable amounts of tritium and some ^{239}Pu. Effluent measurements were maintained and reported to the DOE. The reported estimates of total curies released into the environment are listed in Chapter 8. 30 refs., 24 figs., 29 tabs.

5006 Regulations

REFER ALSO TO CITATION(S) 196, 706, 864, 1700, 1765

1710 **(INIS-mf—11815, pp 308-321) Power suppliers make great efforts to keep air clean.** Feldmann, J. 1987. (In German). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88755285/JAW.

In Reports on the state of the energy discussion 1984/85. Lectures given at a seminar with excursions on the subject 'Problems of energy supply at the levels of the national economy and law' during the autumn and winter trimester of 1984/85 at the Universitaet der Bundeswehr Muenchen.

The paper informs briefly on the most important environmental engineering techniques to abate the release of sulfur dioxide (SO/sub 2/) and nitrogen oxides (NO/sub x/). Since energy policy in the Federal Republic of Germany is committed to the increasing use of coal in fossil-fuel power plants, the explanations are based on that fuel. With oil and gas-fired power plants, corresponding measures can be adopted to abate emissions. (orig./HSCH).

1711 **(PB—88-237599/XAB) Analysis of closures of industries in SIC 24 and 25 as a result of proposed OSHA (Occupational Safety and Health Administration) regulations. Final report.** (Policy Planning and Evaluation, Inc., Vienna, VA (USA)). 25 Jul 1988. 23p. NTIS, PC A03/MF A01.

OSHA's proposed regulations that revise the standards for air contaminants will require many industries to purchase and install air-pollution-control equipment. Some firms may be excessively burdened by the costs of complying with the regulations even to the point of having to close down. The discussion focuses on the tests used to determine the financial ability of firms in SIC 24 and 25 categories to bear the costs imposed by the proposed OSHA regulations; and the derivation of the numbers used to run the tests. The analysis is based on several assumptions, are have also presented in the discussion.

1712 **(PB—88-238209/XAB) Long-range research agenda for the period 1989-1993.** (Environmental Protection Agency, Washington, DC (USA). Office of Research and Development). Mar 1988. 92p. (EPA—600/9-88/008). NTIS, PC A05/MF A01.

This document is prepared in response to a Congressional requirement that the U.S. EPA submit an annual revision of a comprehensive five-year plan of research, development and demonstration. The revision contains the plans for no-growth, moderate-growth, and high-growth budget projections in research. The research is described in media-specific terms - air/radiation, water, pesticides/toxics, hazardous waste/Superfund, multimedia energy, and interdisciplinary issues.

1713 **(PB—88-238373/XAB) Projection methodology for future state-level volatile organic compound emissions from stationary sources (Version 1.8). Final report, September 1983-September 1987.** Emmel, T.E. (Radian Corp., Research Triangle Park, NC (USA). Progress Center). Jul 1988. 134p. NTIS, PC A07/MF A01.

This report presents the model framework used to estimate state-level and national future volatile organic compound (VOC) emissions and control costs for stationary industrial and utility sources. The framework involves a projection approach using the 1980 National Acid Precipitation Assessment Program (NAPAP) inventory for VOC emissions aggregated by 101 defined source categories apportioned by ozone attainment and nonattainment areas for each state. The projection approach involves applying expected industry-activity factors (growth/decline/replacement rates) and emission constraint factors (environmental control reductions) to the base year emission levels. Future-year uncontrolled and controlled VOC emissions and annualized control costs are estimated using annualized control cost values (1980 dollars/ton) for each source category. The model has five data files that interact to provide uncontrolled/controlled VOC emission projections and cost controls for: any year from 1980 to 2030; 49 geographic regions (48 contiguous states and the District of Columbia); and 90 industrial/utility point source categories and 11 industrial area sources.

1714 **(PB—88-238977/XAB) Implications of the Montreal Protocol for atmospheric emissions of alternative chemicals. Report for January-March 1988.** Hummel, K.E.; Smith, N.D.; Harmon, D.L. (Radian Corp., Austin, TX (USA)). Aug 1988. 30p. NTIS, PC A03/MF A01.

This paper is about alternative chemicals. The substitution, of less ozone-depleting chemicals wherever it is cost effective and technically feasible, is expected because of anticipated future limitations on production and consumption of the fully halogenated chlorofluorocarbons (CFCs) and halons (fluorocarbons containing bromine atoms) covered by the Montreal Protocol. Certain alternative chemicals (e.g., HCFC-22 and methyl chloroform) are already used in applications other than as CFC substitutes. Projected future consumption of alternative chemicals includes such non-substitution use. Study results indicate that the 50% reduction in weighted CFC/halon consumption (weighted for ozone-depletion potential) required by the Protocol in 1998 could initially be achieved by alternative chemicals alone. However, alternative processes or products not requiring either the controlled substances or their substitute chemicals and/or substantial recovery and reuse of the chemicals would be needed to maintain the 50% level of reduction in the longer term.

1715 **(PB—88-238985/XAB) US EPA (Environmental Protection Agency) waste-minimization research program.** Freeman, H.M. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Aug 1988. 13p. (EPA—600/D-88/156). NTIS, PC A03/MF A01.

A program to encourage the development and adoption of new production and recycling technologies that result in the production of less hazardous waste was initiated by the U.S. EPA's Office of Research and Development in 1987. The program includes a broad spectrum of demonstration and evaluation audit studies, technical assistance and long-term research studies. It is designed to supplement and support the EPA's waste-minimization strategy being carried out by the Office of Solid Waste. The author reviews progress to date of the various elements of the program and discusses the results of selected waste-minimization audit studies sponsored by the Agency.

1716 **(PB—88-241187/XAB) Review of the Air Quality Criteria for Ozone and Other Photochemical Oxidants. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 22 Oct 1986. 5p. (SAB/CASAC—87/001). NTIS, PC A02/MF A01.

See also PB—87-142949.

This report documents the Committee's findings relative to its review of the Air-Quality Criteria for Ozone and other photochemical oxidants prepared by the Agency's Environmental Criteria and Assessment Office. CASAC unanimously concluded that the document represents a scientifically balanced and defensible presentation and interpretation of the scientific literature.

1717 **(PB—88-241195/XAB) Review of the final Air-Criteria Document for Lead. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 28 Aug 1986. 4p. (SAB/CASAC—86/023). NTIS, PC A02/MF A01.

See also PB—87-142378.

The report documents the Committee's findings relative to its review of the final Air Criteria Document for Lead, and its 1986 Addendum which further evaluated the recent research concerning the relationship between blood-lead and hypertension and the effects of lead exposure on childhood growth and stature. The Committee unanimously concluded that both documents represent a scientifically balanced and defensible summary of the current basis of the authors knowledge of the health effects literature for the pollutant.

1718 **(PB—88-241229/XAB) Recommendation on lead staff paper. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 29 Aug 1986. 5p. (SAB/CASAC—86/024). NTIS, PC A02/MF A01.

In reviewing the second external review draft of the Staff Paper for Lead, the Committee found the document to be clear and appropriate. The Committee makes a number of recommendations concerning improvements in the form and content of the document.

1719 **(PB—88-241237/XAB) Health-effects information relating to particulate matter. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 2 Jan 1986. 4p. (SAB/CASAC—86/008). NTIS, PC A02/MF A01.

The Clean Air Scientific Advisory Committee (CASAC) met on December 16-17, 1985 to hold a preliminary discussion with EPA staff and members of the public on health-effects information relating to particulate matter that has become available since the Committee's last official review of such data. The new scientific information includes: respiratory tract regional deposition patterns; epidemiological studies of mortality and morbidity effects associated with both short-term and long-term particulate exposures; and health effects related to acid aerosols. The preliminary view is that it does not require a fundamental alteration of the structure of the proposed particulate standards at this time or fundamentally change the authors understanding of the mechanisms by which particulate exposures affect public health. There is concern as to whether the current proposed ranges of interest are as scientifically supportable as they were in November 1981 when they were last examined by CASAC.

1720 **(PB—88-242813/XAB) Review of the NAAQS (National Ambient Air Quality Standards) for particulate matter: assessment of scientific and technical information. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 16 Dec 1986. 5p. (SAB/CASAC—87/010). NTIS, PC A02/MF A01.

See also PB—82-177874.

The document is consistent in all significant respects with the scientific evidence presented and interpretation in the combined Air Quality Criteria Document for Particulate Matter/Sulfur Oxides and its 1986 Addendum. The Committee believes that the document should provide the kind and amount of technical guidance that will be needed to make appropriate revisions to the standards. Major conclusions and recommendations concerning the scientific issues and studies discussed in the Staff Paper Addendum are detailed in the report.

1721 **(PB—88-243282/XAB) EPA's (Environmental Protection Agency') risk-assessment methodology for municipal incinerator emissions: key findings and conclusions. Report of the Municipal-Waste Combustion Subcommittee - Environmental Effects, Transport and Fate Committee. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). Apr 1987. 29p. (SAB/EETFC—87/027). NTIS, PC A03/MF A01.

This report presents the findings of the Municipal Waste Combustion Subcommittee of the Environmental Effects, Transport and Fate Committee of EPA's Science Advisory Board's review of the draft document Methodology for the Assessment of Health Risks Associated with Multiple Pathway Exposure to Municipal Waste Combustion Emissions prepared by the Office of Air Quality Planning and Standards and the Environmental Criteria and Assessment Office. While the Committee found the overall methodology to be conceptually thorough, it also identified areas where technical improvements are needed. Since the document will be used to develop a tool for assessing multiple-media exposures from waste-combustions emissions, the Subcommittee outlined specific concerns and recommendations.

1722 **(R—3495-JMO/RC) Timing regulations to prevent stratospheric-ozone depletion.** Hammitt, J.K. (RAND Corp., Santa Monica, CA (USA)). Apr 1987. 72p. NTIS, PC A04/MF A01.

Because of current uncertainty about the likely extent of future ozone depletion and its effects in the biosphere, the central question for current policy is whether to adopt interim regulations to reduce potential ozone depleter emissions now, or to wait several years for improved information. From a global economic perspective, the problem is structured so that both strategies impose equivalent environmental risk. A critical probability is then defined so that immediate regulations will have lower expected cost if and only if the probability that regulations will be necessary exceeds this value. Thus, immediate regulations are cost-justified if and only if policymakers' estimate of the probability that emission reductions will be necessary exceeds the critical probability. Detailed information is incorporated into the model on the cost of reducing emissions and the likely growth of demand for potential ozone depleters. For a wide range of assumptions about the likely growth and elasticity of demand for potential ozone depleters, the possibility that technological innovation will reduce the cost of emission reductions, the date at which improved information will become available, and the horizon used for limiting emissions and calculating costs, the critical probability (initially calculated as 0.36) is remarkably consistent. This suggests that conclusions about appropriate policy should not be overly sensitive to the specific assumptions chosen.

1723 **(SNV—3412) New limits on sulfur in combustion.** (National Swedish Environmental Protection Board, Solna; Statens Energiverk, Stockholm (Sweden)). 1 Dec 1987. 51p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755082/JAW.

New regulation concerning the emission of sulfur from combustion plants are suggested in this report. The emission limits would be 0.05 g sulfur/MJ of fuel for plants emitting more than 400 tons of sulfur/year, and 0.10 g sulfur/MJ of fuel for plants emitting less than 400 tons. The new limits would be introduced gradually from 1993 to 1999, starting in southern Sweden. The new limits will result in a reduction of sulfur emission by 2/3. (L.E.).

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 1619, 1897

1724 **(IAEA-R—4165-F) Geochemical and isotopic studies of unsaturated zone moisture and recharge processes in semi-arid conditions. Final report for the period July 1985 - July 1987.** Edmunds, W. (British Geological Survey, Oxon (UK). Hydrogeology Research Group). (International Atomic Energy Agency, Vienna (Austria)). Jul 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704460/JAW.

Against the background of recent droughts in the Sahel and the overexploitation of scarce water resources, new and improved techniques for recharge estimation in arid lands are now needed. Results have been obtained from the Butana area of Sudan where rainfall is presently well below 200 mm a/sup -1/. Profiles of the unsaturated zone moisture were analysed for solutes and oxygen (δ/sup 18/O) and hydrogen (δD) isotope ratios to estimate the extent of current recharge. Chloride concentrations were compared with those from rainfall inputs and the ratio used to estimate long term recharge values. Direct recharge proved to be below 1 mm a/sup -1/ and the unsaturated zone (25 m approx) contained around 2000 years storage. Isotopic profiles indicated that in some areas discharge from the water table was occurring. Within the Butana region of Sudan, therefore, current recharge rates in interfluve areas are effectively zero. Lateral recharge is however occurring, based on the presence of tritium, from the wadi systems. This forms the only replenishable resource which has been successfully exploited by traditional means, although under stress in the present dry period. The River Nile can be shown from isotopic results to recharge laterally some 10 km; but the deeper resources elsewhere are palaeowaters replenished during Holocene wet periods (6000-8000 BP). 2 refs, 6 figs.

1725 **(ORNL/NERF—3) Gray fox ecology in the Oak Ridge National Environmental Research Park: Food habits, home range, and habitat use.** Greenberg, C.H.; Pelton, M.R.; Parr, P.D. (Oak Ridge National Lab., TN (USA)). Jun 1988. Contract AC05-84OR21400. 173p. NTIS, PC A08/MF A01. Order Number DE89001301/JAW.

Examination of 170 gray fox (Urocyon cinereoargenteus) scats collected between September 1986 and August 1987 on the Oak Ridge Reservation (ORR), East Tennessee, revealed that plant foods were utilized most heavily, followed by invertebrate and animal prey. Proportions of the 3 categories utilized were not evenly distributed among months and were dictated by availability. Biological seasons were delineated by detection of statistically significant shifts in diet among the 3 food categories. Animal prey, predominantly rabbits and rodents, comprised 67.0% of winter (January-April) dry weight (100% occurrence); arthropods, predominantly 17-year locusts (Magicicada sp.), comprised 96.1% of spring (May) dry weight (275% occurrence); plant material, predominantly persimmon, cherry, blackberry and squaw-root, comprised 92.9% of summer-fall (June-December) dry weight (161.6% occurrence). This study indicated that gray foxes may switch dietary trophic level depending on seasonal food availability. 188 refs., 25 figs., 14 tabs.

1726 **(ORNL/TM—10332) Forest bird demography in a landscape mosaic.** Urban, D.L.; Shugart, H.H. Jr.; DeAngelis, D.L.; O'Neill, R.V. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400;AC05-76OR00033. 217p. NTIS, PC A10/MF A01. Order Number DE89001332/JAW.

A tandem approach of field studies and simulation modeling was used to examine avian demography in a landscape mosaic of habitat patches. A particular goal was to attempt to account for the regional decline in abundance of a subset of bird species sensitive to forest fragmentation. Species abundance patterns in forest patches were framed as the consequence of individual birds' demographics, constrained by their landscape context; this context was partitioned to emphasize habitat availability (or area), accessibility (or isolation), and localized factors affecting reproductive success (nest predation and brood parasitism). Each of these constraints was examined in turn, to assess their relative contribution to species abundance patterns observed in landscape mosaics. A forest simulation model was used to develop a theoretical basis for the importance of microhabitat pattern in forest bird communities. Simulated patterns in microhabitat availability could provide for successional trends in bird species diversity, a relation between niche position and species abundance, the occurrence of more rare species than common ones, and a species/area effect. Hypotheses about microhabitat variety and bird species distribution in landscapes were not supported by data from woodlots in Cadiz Township, southern Wisconsin. 39 refs., 41 figs., 10 tabs.

1727 **(PNL-SA—16284) The Multimedia Environmental Pollutant Assessment System (MEPAS) user-friendly shell.** Hoopes, B.L.; Buck, J.W.; Friedrichs, D.L.; Aiken, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 9p. (CONF-881054—28). NTIS, PC A02/MF A01. Order Number DE89001997/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

Pacific Northwest Laboratory (PNL) has developed the Multimedia Environmental Pollutant Assessment System (MEPAS) to prioritize environmental issues based on their potential impact to public health. MEPAS is an objective, physics-based system that quantifies the relative risk to the surrounding population from radioactive and chemical constituents released to the environment. MEPAS uses generally accepted, independently peer-reviewed computer models that simulate constituent migration and fate from the source through designated transport pathways to important environmental receptors, where exposure and relative risk calculations are performed. PNL has provided support in implementing the MEPAS model by supplying an external code, called a shell, that simplifies model operation and execution. The MEPAS user-friendly shell is a menu-driven application written for IBM PC/compatible systems to provide simplified data input, access, modification, and preparation of site data required to estimate potential environmental hazards using MEPAS. 3 figs.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 271, 703, 1679, 1699, 1772, 1773, 1774, 1777, 1778, 1798, 1801, 1805, 1825, 1983

1728 **(AD-A—195946/9/XAB) Remedial investigation of contaminant mobility at Naval Weapons Station, Concord, California. Subtitle Appendix 2.5. 1986/1987. Final report.** Lee, C.R.; O'Neil, L.J.; Brandon, D.L.; Rhett, R.G.; Skogerboe, J.G. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Jun 1988. 129p. (WES/MP/EL—86-2-APP). NTIS, PC A07/MF A01.

See also AD-A165 127.

This report is an appendix to Miscellaneous Paper EL-86-2. It contains corrections and supplemental information to the original report, as well as data collected between June 1986 and August 1987 to supplement previously reported data and to further delineate the extent of contamination at Naval Weapons Station, Concord, California. It also assesses the impact of the 1986 flood on the redistribution of contamination. The derived data include soil analysis, a clam bioassay, and ground-water samples. Wetland boundaries were also delineated.

1729 **(AD-A—196074/9/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Iowa Air National Guard, Des Moines Municipal Airport, Des Moines, Iowa. Final report, August 1984-February 1985.** Buchmiller, R.C. (Geological Survey, Iowa City, IA (USA). Water Resources Div.). Feb 1986. 114p. NTIS, PC A06/MF A01.

Soil and water samples were collected for chemical analyses from unconsolidated loess and glacial till surficial materials at 4

sites on the Des Moines Air National Guard Base. Analyses of samples used gas chromatograph-flame ionization detector (GC-FID) scans on all samples and gas chromatograph-mass spectrometer (GC-MS) on selected samples. Interpretation was based on correlation of GC-FID scan retention time peaks between field sites and samples of known contaminated material or wastes. Results of GC-MS indicate the presence of acenapthene, phenenthrene, pyrene, 1,2-dichlorobenzene, fluoranthene, butylbenzylphthalate, aliphatic hydrocarbons, naphthalenes, cyclohexanes, benzenes, and other organic substances in on or more of the samples. GC-MS analyses indicate the presence of priority pollutants in excess of detection limit concentrations at each site.

1730 **(DPST—88-829) Soil gas and soil plug survey at the Central Shops Diesel Storage Facility (8318).** Looney, B.B.; Price, V.; Masdea, D.J.; Boe, C.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 5 Sep 1988. Contract AC09-76SR00001. 28p. NTIS, PC A03/MF A01. Order Number DE89001645/JAW.

Recently, hydrocarbon contamination of the soils was discovered in the vicinity of the Central Shops (CS) Diesel Storage Facility at the Savannah River Plant (SRP). The contamination is likely the result of the handling and storage of fuel oil, although other potential sources may be present (e.g., a former "lube and oil change area"). The quantity of leakage/spillage is not known. Efforts to remediate recent documented spills included excavation of contaminated soil and engineering improvements to the facility. A preliminary assessment of the area based on a soil plug and soil gas analysis study has been completed. This study was performed by Savannah River Laboratory (SRL) personnel. The purpose of the study was to screen the site to determine the extent and spatial distribution of hydrocarbon contamination. Two types of samples were included in the study: (1) diesel range hydrocarbons were analyzed in soil plugs collected from 18" to 24" deep, and (2) a range of light (C1 to C4) hydrocarbons were analyzed in the free soils gas collected from 24" to 36" deep. The diesel hydrocarbons are an indication of direct contamination by fuel while the light hydrocarbons are breakdown products that provide an indication of nearby or deeper fuel (the relatively mobile degradation compounds diffuse away from the contaminated area). As currently applied by SRL, soil plug and soil gas surveys are used as a screening tool to identify sites that may require further characterization and to help assure cost effective and technically robust development of these characterizations. 1 ref., 12 figs., 3 tabs.

1731 **(LA—11332-MS) Water supply at Los Alamos: Current status of wells and future water supply.** Purtymun, W.D.; Stoker, A.K. (Los Alamos National Lab., NM (USA)). Aug 1988. Contract W-7405-ENG-36. 39p. NTIS, PC A03/MF A01. Order Number DE89002109/JAW.

The municipal and industrial use of groundwater at the Los Alamos National Laboratory and Los Alamos County was about 1.5 billion gallons during 1986. From a total of 19 wells that range in age from 5 to 41 years, the water was pumped from 3 well fields. The life expectancy of a well in the area ranges from 30 to 50 years, dependent on the well construction and rate of corrosion of the casing and screen. Twelve of the wells are more than 30-years old and, of these, four cannot be used for production, three because of well damage and one because the quality of water is not suitable for use. Eight of the twelve oldest wells are likely to be unsuitable for use in the next 10 years because of well deterioration and failure. The remaining 7 wells include 2 that are likely to fail in the next 20 years. Five of the younger wells in the Pajarito well field are in good condition and should serve for another two or three decades. The program of maintenance and rehabilitation of pumps and wells has extended production capabilities for short periods of time. Pumps may be effectively repaired or replaced; however, rehabilitation of the well is only a short-term correction to increase the yield before it starts to decline again. The two main factors that prevent successful well rehabilitation are: (1) chemicals precipitated in the gravel pack and screen restrict or reduce the entrance of water to the well, which reduces the yield of the well, and (2) the screen and casing become corroded to a point of losing structural strength and subsequent failure allows the gravel pack and formation sand to enter the well. Both factors are due to long-term use and result in extensive damage to the pump and reduce the depth of the well, which in turn causes the yield to decline. Once such well damage occurs, rehabilitation is unlikely to be successful and the ultimate result is loss of the well. Two wells were lost in 1987 because of such damage. 29 refs., 15 figs., 15 tabs.

1732 **(NUREG/CR—5183) A user's manual for the contaminant transport module of the MIGRAT code.** Nestor, C.W. Jr.; Pin, F.G.; Reister, D.B.; Witten, A.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning; Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 240p. (ORNL/TM—10830). NTIS, PC A11/MF A01 - GPO. Order Number TI89002246/JAW.

The TRUST computer code, which simulates the movement of mositure in the unsaturated zone, has been modified to the MIGRAT code that provides the capability of simulating the simultaneous transport of up to two retarded and decaying contaminants. The numerical method implemented for contaminant transport in this code has been verified by comparison with an analytic solution for a simple transport problem. This verification demonstrates excellent agreement over the range of model input parameters used in the verification. 8 refs., 20 figs., 3 tabs.

1733 **(PB—88-238969/XAB) Hazardous-waste landfill research, US EPA (United States Environmental Protection Agency) program.** Schomaker, N.B. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Aug 1988. 19p. (EPA—600/D-88/154). NTIS, PC A03/MF A01.

See also PB—84-211028.

The Land Pollution Control Division (LPCD), Hazardous Waste Engineering Research Lab. (HWERL), U.S. Environmental Protection Agency, in Cincinnati, Ohio, has responsibility for research in solid- and hazardous-waste management with respect to land disposal of wastes. To fulfill the responsibility, the LPCD is developing concepts and is documenting the environmental effects of various waste-disposal practices; and is collecting data necessary to support implementation of disposal guidelines mandated by the Hazardous and Solid Waste Amendments of 1984 (HSWA). This paper presents an overview of the land-disposal research associated with the LPCD hazardous waste program plan and will report the current status of work in the following categorical areas: Hazardous-waste facilities - landfills and surface impoundments; Non-Hazardous waste facilities; and Technology transfer.

1734 **(PB—88-868799/XAB) Sanitary Landfills. August 1986-September 1988 (Citations from the COMPENDEX data base). Report for August 1986-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 75p. NTIS PC N01/MF N01.

Supersedes PB—87-864948.

This bibliography contains citations concerning refuse disposal in sanitary landfills. Site selection criteria, leachate analysis and treatment, and economic and management aspects are among the topics reviewed. Hydrologic studies pertaining to contaminant transport, and the utilization of liners and covers are discussed. Considerable attention is given to gas generation and recovery, and specific operations are described. Citations pertaining specifically to hazardous and industrial waste materials are excluded. (This updated bibliography contains 146 citations, 64 of which are new entries to the previous edition.)

1735 **(PB—88-868997/XAB) Cellulose and lignin: biodegradation. January 1978-May 1987 (Citations from the Life Sciences Collection data base). Report for January 1978-May 1987.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 155p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the biodegradation of waste cellulose, cellulose-containing substances, lignin, and lignin-containing substances. Attention is given to the organisms that decompose cellulose and lignin, and the processes by which this takes place. (This updated bibliography contains 379 citations, none of which are new entries to the previous edition.)

1736 **(PB—88-869003/XAB) Cellulose and lignin: biodegradation. June 1987-September 1988 (Citations from the Life Sciences Collection data base). Report for June 1987-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 35p. NTIS PC N01/MF N01.

Supersedes PB—87-862181.

This bibliography contains citations concerning the biodegradation of waste cellulose, cellulose-containing substances, lignin, and lignin-containing substances. Attention is given to the organisms that decompose cellulose and lignin, and the processes by which this takes place. (This updated bibliography contains 65 citations, all of which are new entries to the previous edition.)

1737 **(PNL-SA—15553) In situ heating to detoxify organic-contaminated soils.** Oma, K.H.; Buelt, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 5p. (CONF-880437—1). NTIS, PC A02. Order Number DE89001517/JAW.

From 5. annual Hazardous Materials Control Research Institute conference; Las Vegas, NV, USA (19 Apr 1988).

Pacific Northwest Laboratory (PNL) has undertaken a project to develop and demonstrate an in situ heating (ISH) technique for rendering organic, contaminated soil sites non-hazardous. By heating contaminated soils to elevated temperatures, organic materials can be volatilized and removed, organic volatility tests have proven that soil heating can effectively detoxify organic-contaminated soils. An organic removal efficiency of greater than 99.5% for the moderate-boiling 2-chlorophenol was achieved by heating soil samples to 330{degree}C in a laboratory furnace. A direct current (DC) arcing method was selected for development and demonstration after evaluating several possible ISH concepts. The DC arcing method passes a series of electrical discharges between electrodes inserted in the contaminated soil. Energy dissipated by the discharges heats the soil and volatilizes any organic wastes present in the soil. Removal of organics from soil can be augmented by drawing the volatilized organics to the surface using an induced draft through hollow electrodes. This concept was successfully demonstrated on an engineering-scale test system using soils spiked with 2-chlorophenol as a simulated hazardous chemical. When ISH was performed using the DC arcing method with hollow electrodes to remove volatilized organic vapors, a 95% removal efficiency of 2-chlorophenol from soil was attained. Higher efficiencies are expected as the process becomes more refined. 3 refs., 3 figs., 4 tabs.

1738 **(PNL-SA—15883) Concentrated hazardous organic waste destruction by electrochemical oxidation.** Molton, P.M.; Fassbender, A.G.; Nelson, S.A.; Cleveland, J.K. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 10p. (CONF-881054—25). NTIS, PC A03/MF A01. Order Number DE89001705/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

Concentrated organic compounds typical of major hazardous waste components were subjected to anodic electrochemical oxidation (ECO) in a continuous recycle mode in the presence of a molar nickel nitrate (Ni(II)) electron carrier in molar nitric acid. The catholyte comprised molar nitric acid. Chlorinated compounds such as chlorobenzene, chloroform, perchloro- and trichloroethylene were readily oxidized to a mixture of carbon dioxide and oxygen (the latter from water electrolysis). ECO conversion of phenol rapidly led to insoluble tar formation by a free radical coupling mechanism. The lack of water solubility of most of the compounds examined did not affect the oxidation per se, although it may have contributed to a lower oxidation rate than was previously observed for hexone (MIBK, methyl isobutyl ketone) in solution. A conceptual design for a commercial ECO-system is being developed based on these laboratory results, and work is continuing on the oxidation of mixtures of hazardous materials often found at waste sites. The technique offers promise as a low-temperature and pressure method for waste destruction, especially for concentrated organic wastes. 6 refs., 6 tabs.

1739 **(UBA-FB—86-106) Cycle in the system soil-plant-animal on locations with extremely high soil contaminations by cadmium and nickel caused by sewage-sludge. Final report.** Croessmann, G. (Umweltbundesamt, Berlin (Germany, F.R.)). Mar 1988. 101p. (In German). Umweltbundesamt, Berlin (Germany, F.R.).

Umweltbundesamt - Texte.; no. 8/88.

In 3-year field experiments the uptake and accumulation of cadmium and nickel in vegetable and arable plants had been studied. The soils were characterized by high sorption conditions (clay, organic matter, pH, Fe- and Mn-oxides). The availability of Cd and Ni therefore was rel. low. The aqua regia soluble contents were in the average 157 mg Cd and 558 mg Ni/kg soil, with large variations. The high nitrate concentrations all over the years were remarkable. The Cd-content in kinds of vegetables decreased in the following row: leaves-roots-cale-onion-fruits-potatoes-legumes. Low Cd-contents also had been found in grains of barley and maize. Leave-vegetable and legumes showed higher Ni-contents than other vegetables. Limits and practicabilities of the plant cultivation on high contaminated soils had been discussed under the aspects of transfers into plants and of leaching. Especially the high nitrogen supply and its mobility needs permanent plant cultivation (e.g. industrial plants, plantations). The degradation of sorptive soil conditions increases risk of higher Cd and Ni-availability and leaching processes with unfavourable effects on food chains and on the ecosystem. (orig.) With 47 refs., 52 tabs., 3 figs.

1740 **Simple kinetic fractionation of reactive aluminum in soil solutions.** Bartlett, R.J.; Ross, D.S.; Magdoff, F.R. (Univ. of Vermont, Burlington (USA)). *Soil Science Society of America Journal;* **51**: No. 6, 1479(Nov-Dec 1987). (CONF-881108—). Contract AS05-83ER60179.

From 52. annual meeting of the Soil Science Society; Anaheim, CA, USA (27 Nov 1988).

A method is described that measure empirically the high reactive portion of Al in 50 to 1000-uL soil solution samples such as those removed from field moist soil by pressure, centrifuging, immiscible displacement, or lysimetry. Three categories of Al reactivity are identified in a single sample: rapidly reacting (RR Al), moderately rapid (MR Al), and total reactive Al (TR Al). Compared with other operational kinetic methods for labile Al, this method is applicable to small samples and is quick, simple, and precise because measurement is integrated over a period of minutes rather than confined to a single time point observation. Correcting for Fe interference does not require reduction and complexation procedures that alter Al speciation. Because of its sensitivity to very small changes in reactivity of Al, this method should be useful for the experimental evaluation of possible increases in mobility of biologically active soil Al, such as those hypothesized to be induced by acid precipitation.

1741 **Organic compound effects on swelling and flocculation of Upton montmorillonite.** Chen, S.; Low, P.F.; Cushman, J.H.; Roth, C.B. (Purdue Univ., West Lafayette, IN (USA)). *Soil Science Society of America Journal;* **51**: No. 6, 1444(Nov-Dec 1987). (CONF-881108—). Contract FG02-85ER60310.

From 52. annual meeting of the Soil Science Society; Anaheim, CA, USA (27 Nov 1988).

The swelling and shrinking and flocculation and deflocculation of clays is of fundamental importance in the transport of solutes through a porous medium because these processes affect the permeability of the medium. Since organic solutes frequently occur in toxic wastes, we conducted an investigation of the effect of eight soluble organic compounds, representing different kinds of structures and functional groups, on the swelling and flocculation of sodium saturated Upton montmorillonite. These compounds were ethanol, 1,4-dioxane, phenol, urea, benzamide, ethylamine hydrochloride, acetic acid, and sodium acetate. In general, we found that increases in the concentration of the compounds that ionize in water decreased swelling and increased flocculation to a greater extent than those that remained un-ionized, i.e., electrically neutral. However, 1,4-dioxane was exceptional in that, despite its electrical neutrality, it reduced swelling and increased flocculation significantly. Possible reasons for the effects of the different compounds on swelling and flocculation were advanced.

1742 **Acidification and pH buffering of forest soils.** Magdoff, F.R.; Bartlett, R.J.; Ross, D.S. (Univ. of Vermont, Burlington (USA)). *Soil Science Society of America Journal;* 51: No. 5, 1384(Sep-Oct 1987). (CONF-871180—). Contract AS05-83ER60179.

From 51. annual meeting of the Soil Science Society of America; Atlanta, GA, USA (29 Nov 1987).

Horizons (O, A, E, B, and C) of forest soils from Vermont, New York, New Hampshire, and Virginia were equilibrated with various rates of either acid (H_2SO_4) or base ($CaCO_3$). Most titration curves had a logistic shape with a lower asymptote (between pH 0.3 and 3.1) and an upper asymptote (around pH 7). The lower pH asymptote was highly correlated with equilibration solution Al and with soil pH measured in 1 M NaF. The specific buffer capacity (SBC) of the 26 horizons was related to organic matter (OM). Higher OM levels caused greater SBC. The buffer capacity of the OM was 0.4 mol kg ^{1} OM ^{1} pH ^{1}. Using pH, pH/sub NaF/, OM, and horizon depth, it is possible to estimate the amount of acid currently in the soil (compared to a reference pH). The quantity of acid needed to lower the pH by a given amount, the amount of pH decrease associated with a given amount of acid input, the lower pH asymptote, and the pH at which solution Al is above a given concentration.

1743 **Lead, mercury, cadmium and arsenic in the environment.** Hutchinson, T.C.; Meema, K.M. (eds.). New York, NY; John Wiley & Sons, Inc. ([1988]). 360p. John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10158 $94.95.

From review by D.C. Adriano, Savannah River Ecology Lab., in J. Environ. Qual., Vol. 17, No. 1 (1988).

The author has reviewed the proceedings of a special workshop held in Toronto, Canada in September of 1984. The workshop was organized by the International Council of Scientific Unions' Scientific Committee on Problems of the Environment (SCOPE) subcommittee on metals cycling. This subcommittee is a part of the overall SCOPE Biogeochemical Cycling Committee. The groups addressed the biogeochemical behavior in atmospheric, terrestrial and aquatic systems, behavior in atmospheric, terrestrial and aquatic systems, residence time, and environmental/ecological and (human) health aspects of these elements. Other items discussed included sources (natural vs. antropogenic); sinks; and the needs for national, regional, and eventually global inventories. Also identified was the lack of information on these elements in tropical and subtropical regions. Part II presented individual papers of the review type. The author recommends the volume to both students and researchers.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 135, 214, 254, 270, 1699, 1701, 1704, 1708, 1732, 1825

1744 **(INIS-BR—1278) Some application of the X-ray fluorescence by radioisotopic excitation on rocks and ores.** Seignemartin, C.L. (Sao Paulo Univ. (Brazil). Inst. de Geociencias). 1974. 96p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704521/JAW.

This work presents some principal concepts in which is founded the X-ray fluorescence, by radioisotopic stimulation technic. In the next itens the factors responsible by the introduction of the error in the dosage, and the analytical process are analysed. Some of possible applications of this methodology, principally in the mineral research, following this technique is compared with others analytical methods, including the conventional, X-ray fluorescence. (C.D.G.).

1745 **(JAERI-M—88-106) Hydraulic characteristics of a vertically layered aerated soil.** Mukai, Masayuki. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jun 1988. 18p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755214/JAW.

Safety for ground disposal of LLW is ensured by means of engineered and natural barriers. It is a matter of great importance to conduct an safety evaluation based on the environmental characteristics of Japan, regarding to the migration of radionuclides through aerated and aquifer soil layers acting as natural barrier particularly. In this case, water flow in the soil layers is one of the most fundamental elements of analysis on the migration of radionuclides. The layered soil sample used for this experiment is composed of loamy soil and sandy soil which are most common soil as an aerated soil layer in Japanese plateau. In this experiment, hydraulic characteristics of water permeability and water retentivity for the sample were measured with large size column of 30 cm diameter x 120 cmh. The measured values were compared with the values calculated from the hydraulic characteristics of two kinds of soils, loamy and sandy soils. The purpose of the paper is to make clear the degree of influences of each soil which has different hydraulic characteristic on water permeability and water retentivity of the whole layered soil sample.

1746 **(PB—88-242698/XAB) Health effects of waterborne radon: review of a proposed study. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 5 Sep 1986. 12p. (SAB/RAC—86/028). NTIS, PC A03/MF A01.

The Science Advisory Board's Radiation Advisory Committee was requested to review the scientific merit of a proposal to conduct an epidemiological study of radon in indoor air. The Board accepted the request and formed a Radioepidemiology Subcommittee which responded to two overriding scientific issues: Can further epidemiological study contribute to an understanding of the risks of lung cancer associated with household exposures. The Subcommittee concludes that scientific uncertainties in current epidemiological studies (chiefly studies of uranium miners) could be further reduced through direct investigations of the domestic population. Is the proposed study under review by the Office of Research and Development, entitled Health Effects of Waterborne Radon, appropriately designed to address the risk. For reasons cited in the attached report, the Subcommittee concludes that it is not appropriately designed.

1747 (STUK-A—55, pp 17-24) **Milk and other foodstuffs. Chapter 2.** Rautavaara, A. Jun 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780019/JAW.

In Studies on environmental radioactivity in Finland in 1986. Annual report.

In January-April 1986 the nationwide survey of man-made radionuclides in milk and other foodstuffs covered milk, beef and pork samples. The nationwide, production-weighted mean contents of both /sup 90/Sr and /sup 137/Cs in these foodstuffs were slightly lower than in 1985. The mean content of /sup 90/Sr in milk was 0.10 Bq l/sup -1/. Correspondingly the mean content of /sup 137/Cs was 0.23 Bq l/sup -1/ in milk, 0.9 Bq kg/sup -1/ in beef and 0.2 Bq kg/sup -1/ in pork.

1748 (STUK-A—55, pp 25-55) **Radioactivity in plants and foodstuffs in Lapland 1979-1986. Chapter 3.** Rissanen, K.; Rahola, T.; Illukka, E. Jun 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780019/JAW.

In Studies on environmental radioactivity in Finland in 1986. Annual report.

Radionuclides originating from nuclear weapons tests in the 1950s and '60s were enriched more efficiently in the foodchains of Lapland than in the foodchains of southern Finland. The special foodchains of Lapland were studied by measuring samples of ground and arboreal lichens and of other plants, of reindeer meat, game, fich and berries sporadically from 1979 to 1986. Of artificial radionuclides only /sup 137/Cs activity was detected in these samples, the /sup 137/Cs concentration showing a decreasing trend until April, 1986. In 1983 when 91 lichen samples of Cladonia sp. were collected the /sup 137/Cs concentration was on the average 230 Bq kg/sup r-1/ dry weight, the variation being 74-450 Bq kg/sup -1/. In other fodder plants the /sup 137/Cs concentration varied from 5 to 970 Bq kg/sup -1/ dry weight. The material of most importance in the intake of /sup 137/Cs for Lapps was reindeer meat. This meat contained /sup 137/Cs on average 300 Bq kg/sup -1/ fresh weight in February to April, 1986. The /sup 137/Cs concentration in fish varied from 9 to 87 Bq kg/sup -1/ fresh weight during the whole investigation period 1979-1986, the con-

centration in berries being about half the concentration in fish. These results must be taken into account when analysing the situation after the accident at Chernobyl.

1749 (STUK-A—55, pp 57-74) **Cesium 137 in Lapps in winter 1986. Chapter 4.** Rahola, T.; Suomela, M. Jun 1987. NTIS (US Sales Only), PC A05/MF A01. Order Number DE89780019/JAW.

In Studies on environmental radioactivity in Finland in 1986. Annual report.

From 1962 to 1977 total body cesium 137 measurements were made of a group of Finnish Lapps, by the Department of Radiochemistry at the University of Helsinki using whole-body counting once or twice annually. At the beginning of 1986 it was decided that the Finnish Centre for Radiation and Nuclear Safety together with the Department of Radiochemistry would make measurements for the same Lapp group after an interval of almost ten years. The measurements were performed on April 5-8, three weeks before the Chernobyl accident, with a total of 88 Lapps participating. The aim was to re-estimate the internal dose from cesium-137 calculated in 1976 for one generation (1955-85) using the actual measured cesium 137 values from 1986. The mean cesium 137 body burden for male reindeer herders from Inari was found to be 5200 Bq and for female reindeer herders 2800 Bq. The body burdens for Lapps from other areas were lower, the mean for all men being 3800 Bq and for all women 2000 Bq. On average the cesium 137 burden in 1986 was 70% of the corresponding body burden in 1976. The inclusion of the results of these measurements in dose calculation did not alter the estimated internal effective dose equivalent of 13 mSv for one generation (1955-1985) of reindeer herding Lapps.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 86, 182, 183, 184, 185, 186, 200, 203, 204, 205, 271, 1824, 1826

1750 (CONF-871075—Vol.1-Pt.2, pp 3-19) **In situ stabilization of heavy metals in soil by microbial systems.** Revis, N.W.; Holdsworth, G.; Edenborn, H.M.; Hadden, C.; Elmore, J.L.; King, A.A. (Oak Ridge Research Institute, TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Environmental Protection Agency has approved the concept that heavy metal immobilization in soil, sediment, and sludge is an acceptable form of remediation for hazardous waste sites. Many metal sulfides are highly insoluble in aqueous solution and thus would be relatively immobile in soil and/or sludge. The feasibility of exploiting the activity of naturally-occurring sulfate-reducing bacteria in immobilizing toxic heavy metals as sulfides in soil was examined using the mercury-contaminated East Fork Poplar Creek flood plain as a model system. Laboratory studies indicated that mercury added to sulfate-amended flood plain soils was immobilized rapidly due to enhanced sulfate reduction activity. However, long-term field studies showed that mercury mobility in the soil was extremely low. Further study of the chemical forms of mercury present in these soils using differential extraction procedures strongly suggested that much of the immobilized mercury was already present in the sulfide form. This implies that sulfate reduction activity has been instrumental in the immobilization of mercury in these flood plain soils. The enhancement of sulfate reduction activity in soils and sediments contaminated with mercury and other toxic heavy metals that form insoluble sulfides may be an effective treatment for the remediation of contaminated hazardous waste sites. 20 references.

1751 (CONF-871075—Vol.1-Pt.2, pp 21-23) **Solidification/stabilization of hazardous waste.** Boggs, B.E.; Sargent, T.N. (Engineering-Science, Inc., Atlanta, GA (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

In 1984 amendments to the Resource Conservation and Recovery Act instituted a schedule of banning certain liquid hazardous wastes from land treatment or disposal unless they are appropriately pre-treated before land disposal. Solidification and fixation are two pre-treatment methods being reviewed as appropriate methods for handling the family of metal containing wastes slated for landfill banning. This paper presents a discussion of the landfill ban regulations and describes the role that solidification could perform in implementation of those regulations. Included in this discussion are the regulatory schedule for banning land disposal, a definition of terms related to solidification practices, physical and chemical testing practices used to assess effectiveness of solidification, and how these factors relate to landfill ban requirement.

1752 (CONF-871075—Vol.1-Pt.2, pp 57-78) **Reactivity of various grouts to hazardous wastes and leachates - Phase IV.** Bowers, M.T.; Bodocsi, A.; Carson, D. (Univ. of Cincinnati, OH (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A laboratory study was conducted to evaluate the potential of selected grouts for controlling leachate percolation from hazardous waste landfills and ponds. In this fourth phase of work, four different grouts were subjected to permeability tests and immersion-type reactivity tests. Seven different chemicals and water were used as permeants in the permeability tests, and as liquids for the immersion baths. Of the four grouts, three grouts of microfine cement modified with bentonite (MCB), microsilica (MCS), and emulsified bitumen (CEB) had the lowest baseline permeabilities with water, ranging from 1×10^{-12} to 9×10^{-9} cm/sec. The Penegrout (PEN, urethane) samples had a baseline permeability with water ranging from 4×10^{-9} to 5×10^{-8} cm/sec. The MCB grout exhibited excellent resistance to 100% acetone and 20% $CuSO_4$ but was destroyed by 1N HCl and 25% NaOH. The MCS grout showed excellent resistance to 100% acetone, 100% methanol and 100% xylenes, but was severely damaged by 25% NaOH and destroyed by 1N HCl. The CEB grout offered good resistance to acetone, methanol and xylenes, but was attacked by 25% NaOH and 20% $CuSO_4$. The PEN samples underwent an increase in permeability with all the chemicals used and suffered extreme volume and weight changes (-93 to +76%) with the chemical leachates.

1753 (CONF-871075—Vol.1-Pt.2, pp 79-93) **Evaluation of waste-entrained concrete using image analysis and quantification.** Buckingham, W.F.; Peacock, E.B. (Everest Geotech Co., Houston, TX (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A technique has been developed, tested and is presently being used for disposing of PCB contaminated soil by incorporating the soil into a concrete matrix. A concrete mix is produced consisting of contaminated soil, portland cement and class F fly ash. Following a chemical process which fixes the PCBs to the soil particles, the concrete mixture is poured on site as a monolith, replacing the excavated soil. During the course of the project, leaching procedures (ANS 16.1, MCC-1), permeability and compressive strength tests are performed. The quality of the mix and the blending process are ensured by examining the hardened concrete using a quantitative image analysis system. The concrete is thin sectioned and impregnated with a dyed epoxy. A computer image, from the thin section, is analyzed and the percentage of each solid phase and porosity is measured. The spatial distribution, size and geometric orientation of each phase is measured. Distribution of the contaminated soil in the sample is mapped along with the occurrence of porosity. Multiple samples are analyzed to determine the degree of heterogeneity in the sample. In acceptable samples, the soil occurs as isolated islands less than 1 mm across, in a matrix of portland cement. Porosity is restricted to non-soil zones, lowering the possibility of leaching by percolating ground water. Porosity does not form along soil/cement boundaries indicating good adhesion between these two phases.

1754 (CONF-871075—Vol.1-Pt.2, pp 199-231) **Innovative technologies for hazardous waste treatment.** Anastos, G.J.; Noland, J.W.; McDevitt, N.P.; Williams, R. (Roy F. Weston, Inc. (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

The Superfund Amendments and Reauthorization Act (SARA) has mandated the evaluation of innovative technologies to the end of accomplishing permanent non-land disposal based remedial cleanup for uncontrolled hazardous waste sites. Four such innovative technologies that have been piloted by Roy F. Weston, Inc. (WESTON) and subsequently implemented at multiple sites include: in-situ air stripping of volatile organic compounds (VOCs) in soils; low temperature thermal stripping of VOCs in soils; incineration of explosives and polychlorinated biphenyl compounds in soils; and biodegradation of hazardous organic compounds. WESTON has taken two of these technologies (i.e., low temperature thermal stripping and incineration) further to the point that mobile treatment units are available for cost effective implementation of the technologies at multiple sites. This paper describes the pilot-scale field demonstration of each of these technologies, as well as case studies for implementation of each of these technologies.

1755 (CONF-871075—Vol.1-Pt.2, pp 233-257) **Chemical waste management methodology: development of an expert system for process selection.** Ferrada, J.J.; Holmes, J.M. (Univ. of Tennessee, Knoxville (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A methodology utilizing an Expert Artificial Intelligence System for the selection of technologies, and consultation with a panel of experts for ranking of the technologies is developed for the solution of many hazardous waste problems. The general methodology is briefly described as well as the selected computer-aided expert system. An important phase of the methodology involved the interaction with a panel of experts to account for the social and political impacts of the solutions, in addition to the economic and technical aspects. This phase is analyzed in detail and their results are presented. The methodology is applied to an existing problem in the pesticide industry.

1756 (CONF-871075—Vol.1-Pt.2, pp 259-286) **New treatment technology demonstrations for the Superfund program.** Cudahy, J.; Troxler, B.; Allan, R. (International Technology Corp. (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Both the government and private sector have been very active in promoting the development and demonstration of new thermal treatment technologies in order to meet the best technology requirements of the recent SARA revisions to Superfund. In addition, the strong interest in thermal treatment technologies have been spurred by concerns over long term liability issues. Consequently, a number of technologies have emerged as candidates for dealing with potential problems likely to be encountered under the Oak Ridge Model program. These technologies, in many cases, have already been demonstrated or are strong candidates for demonstration projects as sponsored by the Oak Ridge Model. Among the problems which are potentially addressable through the use of these thermal treatment technologies are mercury and PCB contaminated soils and sludges, treatment of mixed waste sludges to remove the hazardous component and leave only a radioactive waste residue, destruction of PCB contaminated and mixed waste liquids and remediation of major former waste management units. This paper describes some of these technologies which are currently available, the success of their demonstration efforts, the permitting considerations associated with both fixed base and transportable thermal treatment systems and an overview of present commercialization activities.

1757 (CONF-871075—Vol.1-Pt.2, pp 431-450) **Effectiveness of in situ biological treatment of contaminated ground water and soils at Kelly Air Force Base, Texas.** Wetzel, R.S.; Davidson, D.H.; Durst, C.M. (Science Applications International Corp., McLean, VA (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A small-scale soil and ground water treatment system was used to circulate ground water by pumping and gravity injection. Oxygen, in the form of stabilized hydrogen peroxide, and specially formulated nutrients were introduced to the subsurface in order to stimulate microbial degradation of the organic contaminants. Extensive background studies were performed to characterize the site geology and hydrology, determine the contaminant profile, and demonstrate treatability in the laboratory. This project was the first field application of in situ biological treatment at a site contaminated with a complex mixture of both organic and inorganic wastes. The injection/extraction treatment system was operated for a period of approximately eight months during which hydrogen peroxide was added to the subsurface. Nutrients were added for a period of approximately five months. Routine monitoring of the soil and ground water was conducted during system operation to provide data for evaluating the system's performance and controlling its operation. Problems associated with operation of an in situ biological treatment system and useful monitoring parameters are discussed. In addition, results collected from ground water and soil chemical analyses performed during operation of the system are presented. The effectiveness of biodegradation treatment of the organic contaminants was also assessed by documenting changes in the microbial populations. Costs for applying the technology for a generic site were evaluated and compared with those for equivalent technologies. The demonstration project at Kelly AFB has provided a better understanding of the capabilities and limitations of the technology for treatment of organic contaminants in soils and ground water.

5106 Regulations

REFER ALSO TO CITATION(S) 706, 711, 1751, 1828, 1829

1758 (CONF-871075—Vol.1-Pt.2, pp 169-178) **Delisting of industrial waste.** Snider, E.H. (Engineering-Science, Inc., Atlanta, GA (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Wastes can be hazardous in two ways. Any waste which exhibits any of the four hazard characteristics (ignitability, corrosivity, reactivity, or toxicity) is hazardous. Secondly, many waste streams from specific processes or industries have been declared hazardous because they typically contain hazardous constituents or exhibit one or more of the four hazard characteristics. However, waste streams from specific plants and processes, because of treatment or process modifications, may not contain hazardous concentrations of the components which prompted the wastes to be listed originally. Thus, a mechanism was provided to have these specific wastes or waste streams from these specific sources delisted, that is, removed from hazardous waste regulations. Since 1984, supporting data must demonstrate that the waste does not meet the criteria under which it was listed and that the waste does not meet any other criteria under which the waste could be listed. EPA's decision to delist a specific waste is the desired outcome of a lengthy and fairly involved process. Initial contacts between the petitioner and EPA are often informal and verbal. While the petition itself must be fairly detailed, the Sampling and Analysis (S & A) Plan is the heart of the petition and must be clear, explicit and complete. If it is not, EPA will request additional information about processes, personnel involved, sampling methods, analysis methods, quality control/quality assurance data, and so forth. A detailed, well thought out S & A Plan, therefore, can save much time, effort and money at the later stages of the petition process.

1759 (CONF-871075—Vol.1-Pt.2, pp 179-185) **Delisting efforts for mixed radioactive and chemically hazardous waste at the Oak Ridge Gaseous Diffusion Plant.** Goodpasture, S.T. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Presently, there are four hazardous wastes at the Oak Ridge Gaseous Diffusion Plant that are candidates for the delisting from the Resource Conservation and Recovery Act (RCRA) hazardous waste regulations. These candidates are the sludges from K-1407-B and C ponds, Central Neutralization Facility sludges, mixed sludges from Y-12 and the ash generated by the RCRA/Toxic Substances Control Act (TSCA) Incinerator. All of these hazardous wastes contain radioactive constituents as well as hazardous constituents. The delisting will be based upon the nonradioactive constituents. Whether the delisting petition is granted or not, the wastes will be handled according to the Department of Energy guidelines for radioactive wastes. The presentation discusses the methodologies for delisting these wastes and the rationale behind the processes.

1760 **(PB—88-242425/XAB) Criteria for municipal-solid-waste landfills (40 CFR Part 258). Subtitle D of Resource Conservation and Recovery Act (RCRA). Location restrictions (Subpart B). Draft report.** (NUS Corp., Rockville, MD (USA)). Jul 1988. 148p. NTIS, PC A07/MF A01.

In August 1988, the U.S. Environmental Protection Agency proposed Solid-Waste Disposal Facilities Criteria (40 CFR Part 258) for municipal-solid-waste landfills. This background document provides the technical support for Subpart 'B' - Location Restrictions of Part 258. The document contains a discussion of the legislative and regulatory background for understanding the current status of Subtitle D. A discussion of other Federal laws, besides the Resource Conservation and Recovery Act (RCRA), that impact the siting of municipal-waste landfills also is presented. The document also presents detailed information on the revised location restrictions. The location restrictions include the following: airport safety; floodplains; wetlands; fault areas; seismic-impact areas; and unstable areas.

1761 **(PB—88-242433/XAB) Criteria for municipal-solid-waste landfills (40 CFR Part 258). Subtitle D of Resource Conservation and Recovery Act (RCRA). Operating criteria (Subpart C). Draft report.** (NUS Corp., Rockville, MD (USA)). Jul 1988. 108p. NTIS, PC A06/MF A01.

In August 1988, the U.S. Environmental Protection Agency proposed Solid-Waste Disposal Facilities Criteria (40 CFR Part 258) for municipal solid-waste landfills. The background document provides the technical support for Subpart 'C' - Operating Criteria of Part 258. The document contains a discussion of background information and provides detailed information on the revised operating criteria. The revised operating criteria include procedures for: (1) excluding the receipt of hazardous waste; (2) cover-material requirements; (3) controlling disease vectors; (4) monitoring for explosive gas; (5) complying with air criteria; (6) limiting access; (7) controlling run-on and run-off; (8) protecting surface waters; (9) restricting liquid wastes; and (10) recordkeeping.

1762 **(PB—88-242474/XAB) Criteria for municipal-solid-waste landfills (40 CFR part 258). Subtitle D of Resource Conservation and Recovery Act (RCRA). Closure/post-closure care and financial-responsibility requirements (Subpart C, Sections 258.30 through 258.32). Draft report.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Jul 1988. 129p. (EPA—530/SW-88/041). NTIS, PC A07/MF A01.

In August 1988, the US Environmental Protection Agency proposed Solid-Waste Disposal Facilities Criteria (40 CFR Part 258) for municipal solid-waste landfills. The background document provides the technical support for the closure, post-closure core and financial responsibility requirements. The requirements are part of the operating requirements of Part 258. The document contains a discussion of background information and provides detailed information on the revised closure, post-closure, and financial responsibility requirements. This document addresses; (1) closure and post-closure performance stand; (2) closure and post-closure plans; (3) financial-assurance criteria for closure, post-closure, and corrective action for known releases; and (4) financial-assurance mechanisms that are available to owners or operators of municipal-solid-waste landfills.

1763 **(PB—88-242482/XAB) Criteria for municipal-solid-waste landfills (40 CFR Part 258). Subtitle D of Resource Conservation and Recovery Act (RCRA). Design criteria (Subpart D). Draft report.** (NUS Corp., Rockville, MD (USA)). Jul 1988. 114p. NTIS, PC A06/MF A01.

In August 1988, the U.S. Environmental Protection Agency proposed Solid-Waste Disposal Facilities Criteria (40 CFR Part 258) for municipal solid-waste-landfills. The background document 'D' - Design Criteria of Part 258. The document contains a discussion of background information leading to the development of the categorical rule option, and provides detailed information on the revised design criteria. This document discusses the general development of the design criteria while specifically addressing the following items; the various design options considered by the Agency, how the design standard was selected and alternatives considered, how location specific considered ions are involved in the design standard, and what methodologies are available for meeting the design performance standard. The document also provides a discussion of landfill designs, specifically addressing such items as liners, leachate collection systems, and final covers.

1764 **(PB—88-242490/XAB) Criteria for municipal-solid-waste landfills (40 CFR Part 258). Subtitle D of Resource Conservation and Recovery Act (RCRA). Groundwater monitoring and corrective action (Subpart E). Draft report.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Jul 1988. 184p. (EPA—530/SW-88/043). NTIS, PC A09/MF A01.

In August 1988, the U.S. Environmental Protection Agency proposed Solid-Waste Disposal Facilities Criteria (40 CFR Part 258) for municipal solid-waste landfills. The background document provides the technical support for Subpart 'E' - Ground-Water Monitoring and Corrective Action. This document provides detailed information on the development and implementation of the ground-water and corrective-action requirements. Options for the ground-water monitoring and corrective action program are discussed, and rationale explaining the Agency's decisions is presented. The document discusses: (1) ground-water monitoring systems; (2) sampling and analytical requirements; (3) monitoring requirements; (4) ground-water trigger levels; (5) the corrective-action program; (6) remedy selection; and (7) implementation of corrective actions.

1765 **(PNL-SA—16062) Use of Monte Carlo modeling approach for evaluating risk and environmental compliance.** Higley, K.A.; Strenge, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 13p. (CONF-881054—26). NTIS, PC A03/MF A01. Order Number DE89001742/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

Evaluating compliance with environmental regulations, specifically those regulations that pertain to human exposure, can be a difficult task. Historically, maximum individual or worst-case exposures have been calculated as a basis for evaluating risk or compliance with such regulations. However, these calculations may significantly overestimate exposure and may not provide a clear understanding of the uncertainty in the analysis. The use of Monte Carlo modeling techniques can provide a better understanding of the potential range of exposures and the likelihood of high (worst-case) exposures. This paper compares the results of standard exposure estimation techniques with the Monte Carlo modeling approach. The authors discuss the potential application of this approach for demonstrating regulatory compliance, along with the strengths and weaknesses of the approach. Suggestions on implementing this method as a routine tool in exposure and risk analyses are also presented. 16 refs., 5 tabs.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 1619, 1727, 1782, 1997

1766 **(BR—82(11.84)) California sea mussel and bay mussel: Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest).** Shaw, W.N.; Hassler, T.J.; Moran, D.P. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA); Fish and Wildlife Service, Washington, DC (USA)). Sep 1988. 25p. (TR-EL—82-4). US Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458.. Order Number TI89002166/JAW.

Species profiles are literature summaries of the taxonomy, morphology, distribution, life history, and environmental requirements of coastal aquatic species. They are prepared to assist in environmental impact assessment. The California sea mussel, Mytilus californianus, and the bay mussel, M. edulis, are commonly collected for bait. Some commercial landing and aquaculture occurs at a very low level of production. Both species are distributed along the California coast; the sea mussel is more commonly found on intertidal coastal rocks and the bay mussel on pilings and other hard substrates in bays and estuaries. The eggs of both species develop into a trochophore stage in 12--24 hours after fertilization, and the planktonic larval stage lasts 3--4 weeks. Sexual maturity can occur in one year. Spawning of the sea mussel occurs sporadically throughout the year; the bay mussel spawns in central California in late fall and winter. Maximum length is 120--150 mm for the bay mussel and 200--250 mm for the sea mussel. Both species are regarded as unsafe to eat from May 1 to October 31 due to the possible presence of paralytic shellfish poisoning. 55 refs., 4 figs., 5 tabs.

1767 **(PB—88-244645/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 55.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Jul 1988. 773p. NTIS, PC A99/MF E04.

See also PB—88-244652, PB—88-244660 and PB—87-195186.

The document discusses fish use of inshore habitats north of the Alaska Peninsula: June-September 1984 and June-July 1985 and the distribution, seasonal abundance, and feeding dependence of juvenile salmon and non-salmonid fishes in the Yukon River Delta.

1768 **(PB—88-244652/XAB) Fish use of inshore habitats north of the Alaska Peninsula: June-September 1984 and June-July 1985. Final report.** Isakson, J.S.; Houghton, J.P.; Rogers, D.E.; Parker, S.S. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Nov 1986. 378p. NTIS, PC A99/MF E04.

Anticipation of upcoming oil and gas lease sales in the eastern Bering Sea Basin established a need for a greater understanding of the interrelationship of various components of the marine ecosystem of the Bering Sea. The research was designed to provide the baseline descriptions of fish assemblages needed to assess potential and actual impacts of oil and gas development on natural resources of the study area. Primary objectives were to: describe the species composition of demersal and pelagic fish assemblages in poorly-studied nearshore, intertidal, and estuarine habitats of the study area; determine relative abundances of species by habitat, area, and season (spring, summer, and fall); and describe changes in distributions of adults and juveniles occurring over time scales of tide cycles to seasons, including inshore-offshore migrations and directed migrations through the study area.

1769 **(PB—88-244660/XAB) Distribution, seasonal abundance, and feeding dependencies of juvenile salmon and non-salmonid fishes in the Yukon River delta. Final report.** Martin, D.J.; Glass, D.R.; Simenstad, C.A.; Stevenson, M.L.; Grotefendt, R.A. (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Sep 1986. 388p. NTIS, PC A99/MF E04.

In autumn 1984 Envirosphere Company was awarded a contract to conduct a one-year investigation of the distribution, seasonal abundance, and feeding dependencies of juvenile salmon and non-salmonid fishes in the Yukon River Delta. Initial field investigation began with a small synoptic survey which was conducted during December 1984. A larger open-water survey was conducted during June through September 1985. The report contains the results of both surveys and includes an assessment of the potential vulnerability of fish and delta habitats to oil and gas development.

1770 **Buoyancy flow at a two-fluid interface in a porous medium: analytical studies.** Hellstroem, G.; Tsang, C.F.; Claesson, J. (Lawrence Berkeley Lab., CA (USA)). *Water Resources Research;* **24**: No. 4, 493-506(Apr 1988). Contract AC03-76SF00098.

Analytical solutions for the pressure distribution and the flow field are derived for several idealized situations involving an injection well and a vertical plane or cylindrical interface between two fluids of different density and viscosity in an infinite anisotropic aquifer bounded by two horizontal planes. The interface, or transition zone, between the two fluids may be either sharp or of finite width. The buoyancy flow induced by the density difference will cause the two-fluid interface to tilt. A characteristic time scale for the buoyancy tilting rate is deduced. The conditions at the well are found to have only a small influence on the buoyancy flow except very close to the well. The buoyancy flow decreases with increasing width of the transition zone.

1771 **Combined forced-convection and buoyancy flow at a two-fluid interface in a porous medium: analytical studies.** Hellstroem, G.; Tsang, C.F.; Claesson, J. (Lawrence Berkeley Lab., CA (USA)). *Water Resources Research;* **24**: No. 4, 507-515(Apr 1988). Contract AC03-76SF00098.

The motion of a two-fluid interface in an aquifer is a combination of buoyancy flow and forced convection. The buoyancy flow, which is not due to density variations of the fluid, and the forced convection, which acts on the viscosity variations, will cause the two-fluid interface to tilt. The basic case of a plane interface between two immiscible fluids of different density and viscosity in an infinite anisotropic aquifer bounded by two horizontal planes is analyzed in detail. The ground water flow in the aquifer is treated as a superposition of buoyancy flow and forced convection. The buoyancy flow and the forced-convection components are shown by analytical methods to be related to each other. The tilting angle of the two-fluid interface is given by a simple formula containing only two parameters. There exists a certain stationary tilting angle, the stability of which depends on the two viscosities.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 87, 404, 1164, 1679, 1682, 1687, 1699, 1728, 1729, 1732, 1733, 1734, 1743, 1824, 1825, 1842, 1911, 1976

1772 **(AD-A—195524/4/XAB) Installation-Restoration Program (IRP). Phase 2. Confirmation/quantification. Stage 1. McEntire Air National Guard Base, Eastover, South Carolina. Final report, February 1985-June 1986.** Eades, R.; Lapins, A.; Nothwanzer, C.; Zafran, F.; Mentz, J. (Science Applications International Corp., McLean, VA (USA)). 10 Jun 1986. 530p. NTIS, PC A23/MF A01.

Availability: Document partially illegible.

Seven sites were investigated for contamination at McEntire ANGB during the Installation Restoration Program (IRP) Phase II Stage 1. Sites examined included two fire training areas, a sanitary landfill, a liquid waste storage area, an oil dump site, a C-141 spill trench, an unofficial dump site, and a drainage pond/swamp area. The Stage 1 field investigation involved the installation of 23 ground-water monitoring wells and the collection of numerous soil, sediment, surface water, and groundwater samples. Samples were analyzed for volatile organic compounds (VOC), total organic halogens (TOX), total organic carbon (TOC), arsenic and trace metals, oil and grease, total phosphorous, and nitrates. Field measurements of pH, specific conductance, and temperature were also made. Quality Assurance/Quality Control (QA/QC) sampling and analysis, both in the field and in the laboratory, were integral parts of

this effort. Elevated levels for contaminants were identified at 5 of the sites investigated. Contaminants were elevated in groundwater at 4 of the 6 sites where groundwater was examined. Elevated contaminant levels in soil and sediment samples were found at 4 of the 6 sites where these media were sampled. Two sites were without contamination in the media investigated. Elevated contaminant levels were found but not confirmed at the base water supply well W-1.

1773 **(AD-A—195525/1/XAB) Installation-Restoration Program (IRP). Phase 2. Confirmation/quantification. Stage 1. Buckley Air National Guard Base, Colorado. Final report, October-December 1984.** (Dames and Moore, Park Ridge, IL (USA)). 21 Mar 1986. 156p. NTIS, PC A08/MF A01.

The Buckley ANGB Phase II, Stage I field evaluation of the IRP investigated five sites through drilling and sampling nine borings and four monitor wells. Bedrock and alluvial aquifers are of interest in the Buckley ANGB area, particularly since they both provide local and regional water supplies. The bedrock aquifers provide water for the base, but the shallower alluvial aquifers are used within a mile of the base boundaries. The alluvial aquifers, particularly the aquifer associated with East Toll Gate Creek, are vulnerable to contamination. Ground water contamination has been found at Buckley ANGB. Cadmium levels exceeded the primary drinking water standards at the landfill and oil pit zone. TDS, TOX, TOX, and phenolics were also elevated at this site. At Site FT-3, the soil is contaminated, as evidenced by a strong fuel odor and elevated TOX and TOC.

1774 **(AD-A—195612/7/XAB) Installation-Restoration Program Phase 2. Confirmation/quantification. Stage 1. Volume 1. Final report, November 1984-October 1986.** Dowden, J.E.; Ricketts, H.M.; Sheedy, K.A. (Weston (Roy F.), Inc., West Chester, PA (USA)). 10 Oct 1986. 169p. NTIS, PC A08/MF A01.

A problem-confirmation study was performed at seven sites on Selfridge ANGB identified in the Phase I investigation as requiring further study(Southwest Sanitary Landfill, Fire Training Area 2, Fire Training Area 1, West Ramp Fuel Spill Site, Tucker Creek Landfill, Northwest Landfill, and East Ramp Fuel Spill Site). The field investigation was conducted from November 1984 to July 1985 and included installation of 25 monitor wells, collection and analysis of groundwater samples from the monitor wells, and collection and analysis of soil samples from the West and East Ramp Sites. Analysis included VOA, TOC, phenols, COD, cadmium, chromium, copper, lead, nickel, zinc, petroleum hydrocarbons, oil and grease, EP Toxicity, and Ignitibility. Based on the hydrogeologic complexity of the physical setting and the findings of the sampling and analytical work, follow-on investigations were recommended at all seven sites.

1775 **(AD-A—195702/6/XAB) Waste-water and hazardous-waste survey, Homestead AFB Florida. Final report, 10-21 August 1987.** Tetla, R.A.; Attebery, C.W. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Mar 1988. 84p. (USAFOEHL—88-049EQ0088CWA). NTIS, PC A05/MF A01.

Waste-water and hazardous-waste surveys were conducted at Homestead AFB by the USAFOEHL to address possible problems with oil/water separators and to evaluate the hazardous-waste management program. The analytical results from the waste-water survey showed mercury, silver, benzenes, chlorinated benzenes, fuel components, and various purgable halocarbons above the discharge limit presented in the Dade County Code 24-11. Characteristic hazardous waste results showed the separator located outside the jet-engine test cell contained hazardous-waste. The pH of waste water discharged from the base filling-station separator was out of compliance with the Dade County discharge limits. The results of the hazardous-waste survey showed the base hazardous waste program to be running smoothly. The accumulation site managers have a good understanding of the overall waste-management program.

1776 **(AD-A—195703/4/XAB) Hazardous-waste technical-assistance survey, Brooks AFB Texas. Final report, 30 October 1987-15 January 1988.** Tetla, R.A.; Attebery, C.W. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Apr 1988. 77p. (USAFOEHL—88-057EQ0253DHH). NTIS, PC A05/MF A01.

At the request of HQ ATC/SGPB, the USAFOEHL conducted a hazardous-waste technical-assistance survey at Brooks AFB from 30 Oct 87 to 15 Jan 88. The scope of this survey was to address hazardous waste management practices and explore opportunities for hazardous-waste-minimization. The survey team performed a shop and laboratory evaluation of chemical waste management practices as well as met with hazardous-waste managers and engineers to discuss the hazardous-waste program. Recommendations were made.

1777 **(AD-A—195808/1/XAB) Installation-restoration program. phase 2. confirmation/quantification. stage 1. volume 2. Final report, November 1984-October 1986.** (Weston (Roy F.), Inc., West Chester, PA (USA)). Oct 1986. 551p. NTIS, PC A24/MF A01.

See also Volume 1, AD-A195 612; Availability: Microfiche copies only.

The purpose of this task was to undertake a field investigation at Selfridge ANGB MI to: (1) determine the presence or absence of contamination within the specified areas of investigation; (2) if contamination exists, determine the potential for migration of those contaminants in the various environmental media; (3) identify potential environmental and health risk-consequences of migrating discovered pollutants; and (4) identify additional investigations necessary to determine the magnitude, extent, direction and rate of migration of discovered contaminants.

1778 **(AD-A—195811/5/XAB) Investigation of buried pesticide containers (Step 2), Stewart Air National Guard Base, Newburgh, New York. Final report, 23 August 1984-21 October 1985.** (Dames and Moore, Park Ridge, IL (USA)). 30 May 1986. 210p. NTIS, PC A10/MF A01.

This report presents the results of investigations to: 1) confirm and quantify the existence of buried pails of pesticides on the site; and 2) assess the migration of pesticides through soils and ground water. Geophysical surveys using a metal detector and magnetometer revealed a large metallic anomaly in the area of the investigation. Subsequent test pit sampling of soils and liquid wastes in the area of this anomaly confirmed the presence of buried 5-gallon pails of pesticides occupying an area approximately 15x25 feet in plan. Ground-water sampling showed evidence of pesticide contamination at least 30 feet downslope of the burial area. The hydraulic gradient on the site is complex and additional monitoring wells are necessary onsite before a ground-water remediation plan can be properly evaluated. As an interim remedial action, Dames & Moore has proposed that the active source of contamination be removed, even before additional field studies proceed.

1779 **(AD-A—196027/7/XAB) Statistical analysis of ground-water contamination at the alert apron and northern landfill areas of Wurtsmith AFB, Michigan. Final report.** Hunter, P.; Naber, S.; Verducci, J. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Jul 1988. 81p. (USAFOEHL—88-010TS0207AGB). NTIS, PC A05/MF A01.

Two plumes of contamination are analyzed to determine their extent, composition, and movement. The large number of ground-water monitoring wells sampled over the past eight years at Wurtsmith AFB allow this analysis to be performed directly from empirical data, with minimal assumptions about solute transport mechanisms. Conclusions are drawn about the likely sources of contamination in the two plumes, the adequacy of the data for making risk assessments, and the likely consequences of alternative programs of remediation.

1780 **(AD-A—196977/3/XAB) Development of an improved cleaning solution for ROWPU (reverse-osmosis water-purification units). Final report, 29 September 1987-24 March 1988.** Milstead, C.E.; Riley, R.L. (Separation Systems Technology, San Diego, CA (USA)). 11 Apr 1988. 266p. (SST—88-01). NTIS, PC A12/MF A01.

Original contains color plates: All DTIC/NTIS reproductions will be in black and white.

This Phase I program is directed toward the development of an improved cleaning-solution formulation for cleaning fouled ROWPU membrane elements. During this program four primary factors were considered: 1) the chemistry, structure, and properties of the thin-film composite membrane elements qualified for use in Army and Marine Corps ROWPU units, 2) interactions of various chemicals with the membranes, 3) the effect of cleaning solution pH, ionic strength, and temperatures, and 4) the nature of foulants encountered by the membrane elements.

1781 **(CONF-881054—10) Developing a programmatic approach to investigating and remediating many unrelated comprehensive environmental response, compensation, and liability act sites at Kelly Air Force Base.** Kamp, G.; Regan, P.; Ninesteel, R.; Martin, R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01. Order Number DE89001198/JAW.

From 4. annual DOE model conference; Oak Ridge, TN, USA (3 Oct 1988).

Kelly Air Force Base (AFB), which was founded in 1917, is involved in logistics and maintenance activities supporting the Air Logistics Command. In addition, Kelly AFB hosts over 50 tenant organizations representing the Air Force, Department of Defense, and other government agencies. Over the years waste disposal from this complex was conducted in a manner that led to the identification of over 30 sites to be included in the Installation Restoration Program (IRP) after the Phase 1 investigation. A methodology was needed to prioritize the Remedial Investigations and Feasibility Study (RI/FS) activities for the sites. A Strategy Plan was developed that involved reviewing and interpreting existing data, identifying data voids relative to site specific RI/FS activities, and developing methodology to prioritize activities. Sites were prioritized, and a comprehensive IRP planning document was developed. One data deficiency was revealed -- the lack of understanding of the Basewide hydrogeologic conditions necessary to establish an effective restoration program. A Hydrogeologic Investigation was initiated to provide this data. This data will allow better interpretation of the interaction of the sites, particularly those in close proximity, and improved planning of remediation activities.

1782 **(FRCEA-TH—112) Study of the sediment transportation and dispersion, considered as stochastic processes.** Wilson, G. (Paris-6 Univ., 75 (France)). Feb 1987. 419p. (In French). NTIS (US Sales Only), PC A18/MF A01. Order Number DE88755296/JAW.

The longitudinal dispersion of a group of particles subject to a steady and uniform turbulent flow is studied. Two problems are proposed: the longitudinal dispersion through bed load carrying and the longitudinal dispersion through suspension. Various stochastic models are examined and verified with experimental data collected with a radioactive tracer technique.

1783 **(IVL-B—832) Transport and dissemination of pollutants in the aquatic environment.** Martin, A.L. (Swedish Environmental Research Inst., Stockholm). Aug 1986. 198p. (In Swedish). NTIS (US Sales Only), PC A10. Order Number DE88755044/JAW.

The report is a summary of several year's activities in development and examination of techniques for measuring transport and dissemination of industrial pollutants in coastal regions. Theoretical estimates together with hydrographic measurements and tracer techniques are compared as tools, both from effectiveness and cost aspects. Several recent recipient analyses serves as bases of comparison. Known and future techniques are discussed e.g. remote sensing and new tracer elements. (G.B.).

1784 **(LUNBDS-NBLI—1015) Metabolic processes in sediments of acidified and limed lakes with special reference to lake Gaardsjoen, SW Sweden.** Gahnstroem, G. (Lund Univ. (Sweden). Inst. of Limnology). 1987. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755049/JAW.

This study focuses on the effects of acidification and liming processes in lake sediments including sediment respiration, microbial glucose transformation and sediment-water exchange of dissolved substances. The study is part of the lake - watershed study of Lake Gaardsjoen, SW Sweden. Acidification has not significantly changed the rate of glucose transformation or sediment respiration of the studied lakes compared to other non-acidified oligotrophic lakes. This is probably due to pH-buffering in the sediment, since interstitial water pH has remained at pH 6-6.5, except in the uppermost 1-2 cm of the sediment. Liming of L. Gaardsjoen initially decreased the microbial activity in the sediment. After 1-2 months sediment respiration and glucose transformation rate were equal to or higher than before liming. In subsequent years (1982-86) microbial activity in the profundal sediment continued to increase to approx. twice pre-liming values, due to increased input of organic material. The increased microbial activity resulted in an increase in hypolimnetic oxygen deficit in L. Gaardsjoen after liming. The exchange of dissolved substances between sediments and water was greatly influenced by the pH of the overlying and interstitial waters. For example, cations (Ca, Mg) and several metals (Al, Fe, Mn, Cu, Cd, Cr, Zn) were released at experimental acidification. Several processes in sediments counteracts pH-changes. Hydrogen ions are consumed via ion exchange (release of e.g. Ca, Mg) and microbial processes (denitrification, sulphate reduction) in the sediment. Ion exchange between calcium and hydrogen ions may acidify interstitial waters at liming. The buffering of interstitial water pH is of great importance to the organisms living in the sediment.

1785 **(PB—88-230719/XAB) Lake and reservoir restoration guidance manual: first edition.** Moore, L.; Thornton, K. (North American Lake Management Society, Merrifield, VA (USA)). Feb 1988. 297p. NTIS, PC A13/MF A01.

This manual provides guidance to lake managers, homeowners, lake associations, and laypersons on lake and reservoir restoration, management and protection. It also provides information on how to identify lake problems, evaluate practices for restoring and protection lakes, watershed management, and creating a lake-management plan.

1786 **(PB—88-235528/XAB) Effects of mineral-acid deposition on concentrations of dissolved organic acids in surface waters.** Marmorek, D.R.; Bernard, D.P.; Jones, M.L.; Rattie, L.P. (Environmental and Social Systems Analysts Ltd., Vancouver, British Columbia (Canada)). Jul 1988. 120p. NTIS, PC A06/MF A01.

Data have accumulated in recent years from a variety of sources suggesting that concentrations of organic acids may have decreased in surface waters in response to increased mineral acidity. These include laboratory studies, paleoecological investigations, theoretical considerations, and limited field observations of temporal and spatial trends in lake-water chemistry. Failure to consider the suspected changes in organics could result in overestimation of both past and future changes in acid-neutralizing capacity and pH in response to changes in acidic deposition. This paper presents a review of current research on possible changes in surface-water organic-acid concentrations with changes in mineral acidity. The review examines data whereby organic acids might change in response to acidification. It also discusses potential chemical, physical, and biological effects of reduced DOC, and summarizes important research needs.

1787 **(PB—88-235742/XAB) Fiscal Year 1987 program report: Georgia Water Resources Research Institute.** (Georgia Inst. of Tech., Atlanta (USA). Water Resources Research Inst.). May 1988. 49p. NTIS, PC A03/MF A01.

See also report for 1986, PB—87-217394.

The FY 1987 program included the following research projects: Temporal and Spatial Variations in the Radon Content of Ground Water in the Vicinity of the Elberton Batholith of North-

eastern Georgia, Field Methods for Estimating Drought Streamflow Reduction due to Pumping from Nearby Wells, The Value of Forecasting in Reservoir Operation, In-Situ Biological Treatment of Contaminated Ground Water, and Geophysical Methods for Groundwater Location in Crystalline Rock of the Georgia Piedmont.

1788 **(PB—88-235775/XAB) Effects of heavy metal pollution on epilithic bacteria. Technical report (Final).** Ross, D. (Purdue Univ., Lafayette, IN (USA). Water Resources Research Center). Jun 1988. 40p. (PWRRC-TR—184). NTIS, PC A03/MF A01.

The effects of zinc on the bacterial component of periphyton were studied in artificial outdoor streams. Parameters used to measure the response of aufwuchs were biomass, chlorophyll, total and viable bacterial numbers, ATP, heterotrophic activity, and bacterial resistance to zinc. A statistically significant difference was seen with respect to all parameters between low zinc treatments (control, 0.01, and 0.1 ppm zinc) and high zinc treatments (0.1, 1.0, and 10.0 ppm zinc). The bacterial component of aufwuchs showed the capacity to adapt to the exposure level of zinc, but was inhibited by concentrations of zinc above the exposure level. With respect to all parameters, zinc was significantly more toxic under neutral and acid conditions than under alkaline conditions.

1789 **(PB—88-235890/XAB) Computer model for optimizing the operation of a waste-water treatment system dealing with wet weather flows.** Katz, W.J.; Novotny, V.; Lee, D. (WJK Associates Ltd., Milwaukee, WI (USA)). Sep 1985. 71p. NTIS, PC A04/MF A01.

The feasibility of using the Box-Jenkins Auto-Regressive Integrated Moving Average (ARIMA) Models as a tool to control discharges of untreated overflows of combined sewage (CSO's) was investigated. The models can describe the input/output relationships of a sewage system and the components of this system. Operations data were obtained from Kenosha, Wisconsin to test the ARIMA Models. The data included both dry weather and wet-weather operations. The ARIMA Models were examined using an IBM-PC computer. From the preliminary examination, it is highly probable that the ARIMA Models will be of practical use in managing wet weather flows in sewage systems to minimize pollution.

1790 **(PB—88-236054/XAB) Agricultural impact on ground-water quality. Technical report (Final), 1 July 1987-30 June 1988.** Turco, R.F.; Konopka, A.E. (Purdue Univ., Lafayette, IN (USA). Water Resources Research Center). Jun 1988. 62p. (TR—185). NTIS, PC A04/MF A01.

Concern over the possible occurrence of pesticides or nitrate in the ground water is justified as nearly 100% of rural Indiana uses ground water for drinking. A study to assess how groundwater has been affected by agriculture was initiated. Forty-six wells in 4 counties were monitored for pesticides, nitrate, and evaluated as to how placement and depth affects water quality. Findings indicate that nitrate remains of primary concern. While 30% of the tested wells had elevated levels of N, only 8% would be considered a serious risk. It appears that the presence of animals or mishandling of materials in close proximity to the well has the most-detrimental effect. With the exception of one site, contamination of well water by agricultural chemicals is not widespread.

1791 **(PB—88-236062/XAB) Development of estimation methods for tributary loading rates of toxic chemicals. Technical report.** Bierman, V.J.; Preston, S.D.; Silliman, S.E. (Purdue Univ., Lafayette, IN (USA). Water Resources Research Center). Jun 1988. 63p. (PWRRC-TR—183). NTIS, PC A04/MF A01.

Tributary-loading estimation methods were evaluated by conducting retrospective studies with comprehensive sets of field data for flow rates, suspended solids, nutrients, heavy metals, and polychlorinated biphenyls (PCBs) from two different rivers. Three broad classes of leading estimation methods were investigated: simple averaging methods, ratio estimation methods, and regression methods. Estimators were evaluated using Monte Carlo sampling studies in which random subsamples of complete loading records were used to estimate annual loadings. These estimates were then compared to true loadings determined by calculations using the entire record. No single estimation approach was found to be superior for all of the constituents and hydrologic conditions tested.

1792 **(PB—88-238449/XAB) Model assessment for delineating wellhead protection areas. Final report.** van der Heijde, P.; Beljin, M.S. (JACA Corp., Fort Washington, PA (USA)). May 1988. 271p. NTIS, PC A12/MF A01.

This document offers a compilation of ground-water computer-flow models potentially appicable to wellhead-protection-area delineation. It contributes information on existing ground-water flow and contaminant transport and fate models that may be considered for use in these delineations. Each of the 64 personal-computer models described was rated with respect to applied quality assurance, user-friendliness, accessibility, portability, and modificability.

1793 **(PB—88-238456/XAB) Chemical interactions among chlorohydrocarbon mixtures found in wastewater effluents.** Merrick, B.A.; Stober, J.A.; Condie, L.W. (Environmental Protection Agency, Cincinnati, OH (USA). Health Effects Research Lab.). Aug 1988. 22p. (EPA—600/D-88/150). NTIS, PC A03/MF A01.

Various chlorohydrocarbons found in industrial waste effluents, including chloroform ($CHCl_3$) and carbon tetrachloride (CCl_4), can eventually contaminate public drinking water supplies. The present study was designed to evaluate the interaction between orally administered $CHCl_3$ and CCl_4 at hepatic and renal toxic threshold doses in male, Sprague Dawley rats. $CHCl_3$ was administered by oral gavage once daily for 3 days Prior to sacrifice at 0, 0.1, 0.5 and 1.0 mmole/kg/day by itself or in combination with CCl_4 at 0.1, 0.5 and 1.0 mmole/kg (administered by oral gavage 16 hr prior to sacrifice). The severity and frequency of hepatocellular damage increased in a dose-related manner with CCl_4 and to a lesser extent with $CHCl_3$ when they were administered individually. Renal damage was most evident in the highest $CHCl_3$ dose group. Histopathology and serum-enzyme data indicated that hepatotoxicity was greater than additive when CCl_4 and $CHCl_3$ were given in combination.

1794 **(PB—88-238944/XAB) Characterizing raw surface water amenable to minimal water-supply treatment.** Geldreich, E.E.; Goodrich, J.A.; Clark, R.M. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Aug 1988. 30p. (EPA—66/D-88/171). NTIS, PC A03/MF A01.

Monitoring strategy must be sensitive to frequent and unpredictable fluctuations in water quality caused by major storm events and seasonal destratifications of the lake/impoundment. Therefore, daily monitoring of raw source water and the finished-water quality entering distribution systems at a point near the first customer is necessary. When water-quality fluctuations reach beyond the 90th percentile for coliforms, morning and afternoon, afternoon sampling of the finished water should be done to demonstrate continued treatment barrier protection. Monitoring data should not only be utilized to form a continual historical record that demonstrates water-quality suitability for minimal treatment but also as an integral part of guidance in making day-to-day changes in process control to avoid any chance for microbial penetration into the public water supply.

1795 **(PB—88-239082/XAB) Air strippers and their emissions control at Superfund sites. Technical report, February-April 1987.** Blaney, B.L.; Branscome, M. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1988. 25p. NTIS, PC A03/MF A01.

Air stripping, a traditional means of making slightly contaminated ground water potable, is being applied increasingly to more-severe groundwater pollution at remedial action sites. Concentrations of volatile and semivolatile compounds at such sites may reach hundreds of parts per million. As a result, several changes have resulted in air-stripping technology. New air stripping technologies are being employed to achieve very high (>99% removal of volatile compounds and to increase the removal of semivolatiles. New stripper designs are being investigated for compactness and mobility. In addition, emissions controls are being added because

air-pollution impacts are larger. The paper discusses these trends and provides examples from ground-water cleanup at remedial-action sites in the United States.

1796 **(PB—88-239090/XAB) Alternative energy sources for waste-water treatment plants. Final report, October 1981-August 1983.** (Weston (Roy F.), Inc., West Chester, PA (USA)). Aug 1988. 132p. NTIS, PC A07/MF A01.

This technology assessment provides an introduction to the use of several alternative energy sources at waste-water treatment plants. The report contains fact sheets (technical descriptions) and data sheets (cost and design information) for the technologies. Cost figures and schematic diagrams of the technologies are included. The following alternative energy technologies appear to be potentially cost-effective: Heat pumps which use influent or effluent waste water as their heat source, for supplying process or building heat; Geothermal direct-use systems for large energy loads when geothermal source is adequate; Wind-power systems for large electrical loads when annual wind flux is adequate; Passive solar systems where they can be cost-effectively integrated into the overall architectural design of a facility; Low-head hydro systems may be appropriate for smaller plants which have an available head greater than three meters.

1797 **(PB—88-239389/XAB) Fiscal Year 1987 program report: Delaware Water Resources Center.** (Delaware Univ., Newark (USA). Water Resources Center). Jul 1988. 36p. NTIS, PC A03/MF A01.

See also PB—87-229399.

The Fiscal Year 1987 Delaware Water Research Institute Program focused on three critical water problems of the state and region: contamination of ground water, maintenance of a safe and adequate water supply, and sedimentation. Five projects developed information needed by water planners, managers, and users for the protection and maintenance of Delaware's ground-water supply. Included are methods for cleanup of toxic organic compounds and petroleum products, a system for identifying water-table regimes by soil characteristics, an analysis of soil types and herbicides that quantifies potential movement of toxins into certain aquifers, and a study of watershed land use and the related impact on water quality. A sixth project explored an alternative to chlorination as a water-treatment method. The final project identified causes of riverbank erosion and a natural deterrent to such erosion.

1798 **(PB—88-241203/XAB) Report of the Ecological Risk-Assessment Review Subcommittee: review of the Office of Research and Development's ecological risk-assessment program. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 16 Jan 1987. 27p. (SAB/EC—87/017). NTIS, PC A03/MF A01.

The Ecological Risk-Assessment Research Review Subcommittee's major conclusion was that the overall concept of ecological risk assessment developed in the program is comprehensive, scientifically ambitious, and sets forth a research direction for the long term (perhaps twenty years). In the short term (five years), it is not achievable as planned, particularly because some of the key elements (density-dependent population, community and ecosystem mechanistic models) are based on an incomplete understanding of the fundamental mechanisms. However, the research staff have made a promising start in identifying some of the major issues the program should address.

1799 **(PB—88-242664/XAB) Review of EPA (Environmental Protection Agency) water-quality-based approach research program.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 11 Dec 1986. 62p. (SAB/EC—87/011). NTIS, PC A04/MF A01.

As part of a series of Science Advisory Board ongoing reviews on the ORD research program, the SAB reviewed a document entitled Reference Material for SAB Review of Water-Quality-Based Approach for the Control of Toxics - Freshwater. The document was prepared by four EPA laboratories that carry out research in this particular program. The Subcommittee's major conclusion was that methods for deriving water quality criteria have undergone a steady evolution and extensive scientific review. The scientific and regulatory communities have widely accepted the resulting criteria. Additional Subcommittee recommendations were directed at further strengthening the water-quality-based approach, and integrating it with work related to other areas of toxic controls needing attention.

1800 **(PB—88-242847/XAB) Review of ORD's (Office of Research and Development's) Integrated Air Cancer Project. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 25 Feb 1987. 19p. (SAB/EC—87/023). NTIS, PC A03/MF A01.

The Agency has addressed the carcinogenic potency of mixtures of materials in the ambient air which is a critical step towards characterizing the exposure of humans to a complex environment. The Integrated Air Cancer Project was found to be scientifically well-founded. The project represents a logical and appropriately innovative approach that can achieve its long-range goals of addressing these complex environmental-health issues. In addition, the project effectively exploits some of the research tools and results developed in the past decade and presents an example of effective multi-laboratory research management within the Agency.

1801 **(PB—88-243787/XAB) Freeboard determination and management in hazardous-waste surface impoundments. Final report.** Johnson, S.H.; Anderson, D.C. (Brown (K.W.) and Associates, Inc., College Station, TX (USA)). Aug 1988. 103p. NTIS, PC A06/MF A01.

A rule-of-thumb minimum freeboard requirement of two feet (60 cm) has been used in the past for hazardous-waste surface impoundments. In many situations, however, this minimum value may not be sufficient to prevent overtopping. Consequently, a procedure was developed for calculating freeboard values in surface impoundments where the liquid depths are shallow and the fetches are short, as is typical in hazardous-waste surface impoundments. The procedure takes into account all of the parameters that influence freeboard and presents the information in a format that can be used on a site-specific basis. Additional support information in the report includes an example calculation of freeboard requirement, site-specific data obtained from research using a mass-liquid balance, and a listing of the various types of liquid-level detection equipment.

1802 **(PB—88-244751/XAB) Fiscal Year 1987 program report: Rhode Island Water Resource Research Center.** Poon, P.C. (Rhode Island Univ., Kingston (USA). Water Resources Center). Jul 1988. 52p. NTIS, PC A04/MF A01.

See also report for FY 1986, PB—88-104690.

The 1987 program objective was to conduct studies and research of value to the New England region as well as to assist in the solution of problems in the State of Rhode Island. Current and anticipated state and regional-water problems are contamination of surface and groundwater by natural radioactivity such as radon, by chemicals from industrial and agricultural activities, septic tank and leach field, improperly managed landfills and the lack of public awareness and public participation in water-quality protection and management. It was found in the 1987 program that an epithermal neutron-activation analysis was best suitable for measuring uranium and thorium of which radon is the decayed product. Lower U and Th were found in calc-alkalic and mafic volcanic rocks while higher concentrations were found in the alkalic and peraluminous rocks. A computer model using finite-element method to simulate fluid flows through fractured porous media was developed for predicting the extent of ground-water contamination in the State.

1803 **(PB—88-868377/XAB) Microbiology of ground water. January 1977-August 1988 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-August 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 130p. NTIS PC N01/MF N01.

Supersedes PB—87-866968.

This bibliography contains citations concerning the enumeration, characterization, movement, and monitoring of microorganisms in potable and nonpotable groundwater from a wide variety of natural and anthropogenic sources. Considerable attention is given to the effects, treatment, and removal of various microorganisms contained in groundwater. (This updated bibliography con-

tains 202 citations, 17 of which are new entries to the previous edition.)

1804 **(SNV—3149) Acidification of the high mountains of Swedish Lapland. Survey of the water chemistry of watercourses and of snow in connection with the spring-floods in 1980-1984 in the Taerna area.** Bjaernborg, B. (National Swedish Environmental Protection Board, Solna). Jul 1986. 68p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755070/JAW.

The water chemistry of mountain brooks has been studied in the Taerna-Hemavan area of the southern part of the Swedish Lapland high mountains. The aim of the study was to confirm and describe the occurrence of acidification effects in connection with the spring flood, which had been reported in 1979 in a regional study. Analyses were performed with respect to pH, major ions, metals, phosphorous and nitrogen compounds. When the water discharge reached maximum during the spring flood, the concentrations of dissolved compounds decreased by a factor 4 to 10, whereas the total concentrations of e.g. aluminium, iron, phosphorous and nitrogen increased drastically. Speciation studies showed that aluminium and iron were mainly in a particle-bound form. The study shows that the load of acidifying substances via the snow is high enough to cause short-term acid surges in those parts of the high mountains of Lapland that are poor in lime. On the other hand, in calcareous parts of the mountains such acid surges still occur relatively seldom. Regarding the extreme dilution of an already low buffering capacity of brook water during the spring flood and the often very thin soil cover at high altitudes, the non-calcareous areas of the high mountains must be regarded as being extremely sensitive to any further acidification of the precipitation. Already today there is a risk for such areas to suffer more serious acidification damages than have been observed in this study.

1805 **(SNV—3209) Focus on environmental impacts of petrochemical plants in Stenungsund.** (National Swedish Environmental Protection Board, Solna). Apr 1987. 140p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755073/JAW.

The picture of the environment in Stenungsund that has evolved during the course of the investigation is mainly bright. In most cases the emissions have proven to have relatively little impact on health and the environment. The health conditions in Stenungsund do not differ from conditions in comparable towns not having a petrochemical industry. The impact on water and soil has been minimal. But this picture also has its murkier sides. The emission of some substances, primarily ethylene, can, given certain conditions, lead to a greater risk of cancer. This conclusion is based on uncertain premises and is a worst-case situation. Noise and odours are problems in some residential districts and the forest downwind of Stenungsund has suffered unmistakeable damage.

1806 **(SNV—3320) Environmental quality in the seas surrounding Sweden. Part 1. Background data for 'Plan of action against sea pollutants'.** Bergstrand, E.; Jonsson, P.; Eriksson, G.; Jansson, B.; Nystroem, E. (Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping (SE); Statens Naturvaardsverk, Solna (SE)). (National Swedish Environmental Protection Board, Solna). May 1987. 98p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755075/JAW.

In August 1986 the Swedish government appointed an action committee against sea pollution. At the request of the committee, the National Swedish Environment Protection Board presented a plan of action in May 1987. The report is one of five appendices to the plan. Main headings of the report: -Hydrography, -Nutritional status, -Oxygen conditions, -Heavy metals, -Stable organic compounds, -Oil.

1807 **(SNV—3321) Measures within agriculture. Part 2. Background data for 'Plan of action against sea pollutants'.** Rundqvist, B.; Andersson, R. (National Swedish Environmental Protection Board, Solna). May 1987. 55p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755076/JAW.

In August 1986 the Swedish government appointed an action committee against sea pollution. At the request of the committee, the National Swedish Environment Protection Board presented a plan of action in May 1987. The report is one of five appendices to the plan. Main headings of the report: Measures; -Long term strong measures, -Barnyard manure, -Keepeng the cultivated landscape stocked, -Manuring planning, -Drainage from farming. Effects; Accomplishment; Research requirements.

1808 **(SNV—3322) Measures within local urban and rural districts and within industry. Part 3. Background data for 'Plan of action against sea pollutants'.** Rasmuson, U.; Lindgren, H.R. (National Swedish Environmental Protection Board, Solna). May 1987. 94p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755077/JAW.

In August 1986 the Swedish government appointed an action committee against sea pollution. At the request of the committee, the National Swedish Environment Protection Board presented a plan of action in May 1987. The report is one of five appendices to the plan. Main headings of the report: -Stable organic compounds, -Measures regarding metals, -Nutrient salts.

1809 **(SNV—3323) Research, supervision, information etc. Part 4. Background data for 'Plan of action against sea pollutants'.** Oelundh, E.; Cederwall, H.; Hulten, J.; Rasmusson, G.; Eriksson, G. (National Swedish Environmental Protection Board, Solna). May 1987. 39p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755078/JAW.

In August 1986 the Swedish government appointed an action committee against sea pollution. At the request of the committee, the National Swedish Environment Protection Board presented a plan of action in May 1987. The report is one of five appendices to the plan. Main headings of the report: -Marine R and D, -Follow-up of state and effects in marine environment, -Physical planning, -Information and educational measures, -Marine reserves in Sweden.

1810 (UCRL—21008-Vol.9, pp 2.1-2.68) **Health risks associated with physical properties and chemicals of military concern in field water.** Daniels, J.I.; Gratt, L.B.; Lyon, M.; Perry, B. Feb 1988. NTIS, PC A10/MF A01. Order Number DE88013814/JAW.

In Evaluation of military field-water quality. Volume 9. Data for assessing health risks in potential theaters of operation for US military forces: [Final report].

In this chapter the authors identify the safe levels for total dissolved solids (TDS), magnesium (Mg^{+2}), sulfate (SO_4^{-2}), arsenic (As), cyanide (CN^-), and the pesticide lindane in field water and present data for assessing the health risks for military personnel drinking water containing concentrations of these substances that are above recommended levels. These data are summarized in figures that are visual guides for quickly assessing the relationship between the concentration of a particular substance of concern in field water and the corresponding health risks for military personnel as a function of consumption rate and exposure period.

1811 (UCRL—21008-Vol.9, pp 3.1-3.27) **Regions of concern with regard to inorganic chemical constituents of field water.** Crow, N.B. Feb 1988. NTIS, PC A10/MF A01. Order Number DE88013814/JAW.

In Evaluation of military field-water quality. Volume 9. Data for assessing health risks in potential theaters of operation for US military forces: [Final report].

There are several inorganic constituents of field waters that could pose health risks to military personnel. In most areas of the world inorganic substances dissolved in field waters will not represent a threat to military personnel, as concentrations of the dissolved substances are not high enough to cause health effects. However, there are regions where dissolved (inorganic) constituents could be a problem: most of these are hot, arid regions or areas where natural waters come in contact with exposed mineral deposits, such as salt, gypsum, or metal ores. In this chapter they identify areas that are likely to have water resources that contain elevated levels of dissolved inorganic substances. Their analysis are meant to provide information that is indicative of the water quality in different areas. The overview presented can be used to identify the geo-

graphic locations worldwide where it is important for water-quality monitoring to be performed.

1812 (UCRL—21008-Vol.9, pp 4.1-4.6) **Regions of concern with regard to organic chemical contamination of field water.** Kelly-Reif, J. (Univ. of California, Davis (USA)). Feb 1988. NTIS, PC A10/MF A01. Order Number DE88013814/JAW.

In Evaluation of military field-water quality. Volume 9. Data for assessing health risks in potential theaters of operation for US military forces: [Final report].

In a previous study, they made a comprehensive survey of organic chemicals found in natural waters. Their analysis of the available data showed that organic compounds are typically detected at concentrations that are not high enough to cause systemic effects or adverse organoleptic responses. Ordinarily, only pesticides, particularly lindane, may occur at a high enough concentration in potential sources of field water to be a military health concern. Nevertheless, transient releases from industrial facilities storing large quantities of organic chemicals and transshipment points could result in elevated levels of organic contaminants in surface waters. Although it is not possible to list all such facilities that are of potential concern, they have identified major production centers and petroleum refineries that could constitute potential sources of surface water contamination. Information on the locations of these facilities can alert military planners to potential water-supply contamination by organic chemicals under battlefield conditions. They also describe the geographic regions worldwide that could contain field water with elevated levels of pesticides, especially lindane. These elevated levels of pesticides, particularly lindane, occur as a consequence of the application procedures practiced in agricultural areas.

1813 (UCRL—21008-Vol.9, pp 7.1-7.3) **Health hazards of contaminated field water to military personnel.** Daniels, J.I.; Layton, D.W. Feb 1988. NTIS, PC A10/MF A01. Order Number DE88013814/JAW.

In Evaluation of military field-water quality. Volume 9. Data for assessing health risks in potential theaters of operation for US military forces: [Final report].

This volume of Evaluation of Military Field-Water Quality contains data that military risk managers can use to assess the potential performance-degrading health effects that a concentration of a particular constituent of military concern in field water (i.e., physical property, chemical, or infectious organism) could produce in exposed personnel. Accompanying these data is an evaluation of the general physical, chemical, and biological quality of field water in geographic regions worldwide, which alerts military decision makers to the locations of possible concern with regard to field water in potential theaters of operation for US military forces.

1814 **(WHC-EP—0172) Inventory of chemicals used at Hanford production plants and support operations (1944-1980).** Klem, M.J. (Westinghouse Hanford Co., Richland, WA (USA)). Jul 1988. Contract AC06-87RL10930. 58p. NTIS, PC A04/MF A01. Order Number DE89001898/JAW.

A complete list of chemicals used in the production facilities and support operations of the US Department of Energy Hanford Site is presented to aid development of plans for characterizing the radioactive liquid chemical wastes stored in the 149 single-shell tanks. The complete chemical list is compared to the list provided by the regulatory agencies to identify hazardous chemicals stored in the single-shell tanks. The reduced list will be used to identify the chemical constituents in the single-shell tank sampling program. The chemical list is based on chemical process flowsheets, essential material consumption records, letters, reports, and other historical data. 35 tabs.

1815 **Evaluation of chemical oxidizers for hydrogen sulfide control.** Cadena, F.; Peters, R.W. (New Mexico State Univ., Las Cruces (USA)). *Journal - Water Pollution Control Federation;* **60**: No. 7, 1259-1263(Jul 1988).

Theoretical hydrogen sulfide oxidation reactions are reviewed. Stoichiometric requirements were determined for typical waste water samples. To oxidize 1 g of sulfide in laboratory conditions 2.4, 4.2, and 11.8 g of hydrogen peroxide, chlorine, and potassium permanganate, respectively, were required. First-order kinetics with linear sulfide generation describe the hydrogen sulfide oxidation with hydrogen peroxide. The kinetic constants for sulfide oxidation and in vitro generation are 0.120 min^{-1} and 0.38 mg/L x h. Chlorine compound and potassium permanganate oxidation reactions are complete in less than 5 minutes contact time.

1816 **Fiber optic fluid detector.** Angel, S.M. US Patent Application 6-019,841. 27 Feb 1987. 31p. Contract W-7405-ENG-48. NTIS, PC A03/MF A01.

Particular gases or liquids are detected with a fiber optic element having a cladding or coating of a material which absorbs the fluid or fluids and which exhibits a change of an optical property, such as index of refraction, light transmissiveness or fluoresence emission, for example, in response to absorption of the fluid. The fluid is sensed by directing light into the fiber optic element and detecting changes in the light, such as exit angle changes for example, that result from the changed optical property of the coating material. The fluid detector may be used for such purposes as sensing toxic or explosive gases in the atmosphere, measuring ground water contamination or monitoring fluid flows in industrial processes, among other uses. 10 figs.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 129, 166, 169, 170, 1209, 1211, 1699, 1701, 1704, 1708, 1709, 1732, 1746, 1787, 1802

1817 **(AD-A—195655/6/XAB) Filtration system for removal of depleted uranium from water. Final technical report, 11 June-31 December 1987.** Farrell, L.T.; Bartlett, P.T.; Olechiw, W.J. (TTI Engineering, Norwood, MA (USA)). Feb 1988. 104p. NTIS, PC A06/MF A01.

Previous depleted-uranium munitions testing at Eglin AFB has resulted in 500 to 35,000 gallons of waste water containing: a. DU concentrations from 2.5 x 10^{-5} to 9 x 10^{-8} microcuries/mL. b. DU particles equal to and greater than 0.1 micron in size. Eglin personnel reasoned that if particles could be filtered from the waste water down to a 0.1 micron size, the waste water could be disposed of on-site and comply with the Nuclear Regulatory Commission (NRC) standard of 35 pCi/g of soil. The objective of the program was to compare the effectiveness of three cross-flow membrane modules using a pilot-scale microfiltration system that was: (1) designed to process the waste water described above, and (2) designed to allow direct scale-up to a system that is capable of processing 35,000 gallons of waste water that can then be disposed of on-site within applicable standards.

1818 **(INIS-mf—11796) Radioactivity measurements in the Lake of Constance after the Chernobyl reactor accident.** (Internationale Gewaesserschutzkommission fuer den Bodensee). 1987. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755163/JAW.

Internationale Gewaesserschutzkommision fuer den Bodensee. Bericht.; no. 36.

On the basis of measured values reported, the experts interpret the situation in this important water reservoir from the perspective of water protection, and with a view to the long-term, future effects of the radioisotopes from the Chernobyl fallout on the entire ecosystem in that region. Main items discussed are: radioactivity uptake by the lake water in the months April and May 1986, radioactivity distribution and deposition in the lake (water, sediments, suspended matter, plankton, fish), and the effects on the latter, particularly the sediments. The final chapter discusses the experience and knowledge gained with other waters in the F.R.G. that have taken up radioactivity from the Chernobyl accident.

1819 **(INIS-mf—11798) Studies on hydrosphere contamination from radioactive atmospheric emissions released in a nuclear accident.** Schwarz, G.; Goertz, R.; Altmeyer, H.D. (Brenk Systemplanung Ingenieurbuero fuer Wissenschaftlich-Technischen Umweltschutz, Aachen (Germany, F.R.)). Sep 1985. 126p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88755164/JAW.

The transport of depositions on the earth's surface into the hydrosphere is investigated. For this purpose, the basic hydrological transport and distribution pathways are presented which are liable to lead to a contamination of the flowing waters and the aquifers of the catchment area. Some of the most important transport pathways are (1) direct deposition on the water surface, (2) retarded and instantaneous erosion of soil deposits by the erosive effect of the surface run-off of rainwater, and (3) transport of soil deposits by the groundwater pathway or by subsurface run-off. The relevant quantitative methods for the description of these transport processes are presented and discussed. On this basis, a simplified hydrological transport model is set up which meets the requirements of an analysis of the consequences of accidents. Attempts at a verification of the simplified hydrological transport model - by means of available data on fallout from nuclear weapons - make the model appear to be a suitable instrument for the assessment of accident consequences. Moreover, the model is exemplarily applied for the case of radioactive contamination of parts of the Danube catchment area by a postulated nuclear reactor accident.

1820 **(IOS-Rep—219) Methods for the shipboard determination of dissolved iron and manganese in samples of sediment interstitial water.** Hydes, D.J.; Chapman, E. (Institute of Oceanographic Sciences, Godalming (UK); Department of the Environment, London (UK)). 1986. 36p. (DOE-RW—86.137). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780100/JAW.

Iron is extremely unstable in the presence of oxygen. A working atmosphere containing less than 0.2% oxygen is required if iron losses are not to be significant. Iron can be determined with a single addition of reagent, either manually or by a continuous flow procedure using ferrozine. Using a continuous flow procedure with a 5 cm colorimeter cell the method is linear up to 40 3=M Fe and the precision is 2%. Manganese can similarly be determined with a single reagent addition using formaldoxime. For the continuous flow procedure with a 5 cm colorimeter cell the method is linear up to 60 3=M Mn and the precision is 1%; however, under these conditions a solution containing 100 3=m of iron produces an interference equivalent to 4.7 3=M of manganese. A two-reagent procedure was developed using EDTA to suppress the iron interference. Using a 5% EDTA solution interference from a solution containing 100 3=M of iron was undetectable.

1821 **(PB—88-235551/XAB) Radium removal for a small community water-supply system. Research report, 1 October 1985-30 September 1987.** Mangelson, K.A. (Rocky Mountain Consultants, Inc., Englewood, CO (USA)). Jul 1988. 70p. NTIS, PC A04/MF A01.

In 1984, a radium-removal treatment plant was constructed for the small community of Redhill Forest located in the central mountains of Colorado. The treatment plant consists of a process for removing iron and manganese ahead of an ion-exchange process for the removal of radium. The raw water comes from deep wells and has naturally occurring radium and iron concentrations of about 30-40 pCi/L and 7-10 mg/L, respectively. Before the raw water enters the main treatment plant, the raw water is aerated to remove radon gas and carbon dioxide. The unique features of the Redhill Forest Treatment Plant are related to the ways in which the radium removed from the raw water is further treated and eventually disposed of as treatment plant waste. A separate system removes only radium from the backwash/regeneration water of the ion exchange process and the radium is permanently complexed on a Radium Selective Complexer (RSC) resin made by Dow Chemical. The RSC resin containing radium is replaced with virgin resin as needed and the resin waste transported to a permanent final disposal site in Beatty, NV. This report presents a detailed description of the Redhill Forest treatment system and the results of in-depth monitoring of the processes and other factors relating to the overall operation of the radium-removal system. Included are descriptions of modifications made in the plant operation to improve the overall system operation and of the procedures for final disposal of the RSC resin-containing radium.

1822 **(PB—88-237904/XAB) Full-scale radium-removal system for a small community. Research report, 1 October 1985-30 September 1987.** Lauch, R.P.; Mangelson, K.A. (Redhill Forest Property Owners Association, Fairplay, CO (USA)). Aug 1988. 15p. NTIS, PC A03/MF A01.

A radium-removal treatment plant was constructed for the small community of Redhill Forest in the central mountains of Colorado. The plant consists of iron removal using oxidation, filtration, and settling; radium and hardness removal using ion exchange; and radium removal from the waste brine using Dow Chemical Company's Radium Selective Complexer (RSC). The raw water comes from deep wells and has naturally occuring radium and iron concentrations of about 30-40 pC/L and 7-10 mg/L, respectively, and is aerated before entering the main treatment plant to remove radon gas and carbon dioxide. A unique feature of the plant is the process that removes radium from the waste brine. The process removes only radium from the spent ion-exchange regeneration water by permanently complexing the radium on the RSC. The RSC is replaced when exhausted and sent to a final disposal site that is acceptable to state regulatory agencies. The overall plant reduces radium from about 35 pCi/L to less than 4 pCi/L. The RSC system has consistently removed over 99% of the radium from the spent ion exchange regenerant. The average inflow radium concentration to the RSC was about 1180 pCi/L, and the average effluent was about 9 pCi/L.

1823 **(PB—88-242714/XAB) Radionuclides in drinking water and four draft criteria documents: man-made radionuclide occurrence, uranium, radium, radon. Review of the Office of Drinking Water's assessment. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 27 Jul 1987. 20p. (SAB/RAC—87/035). NTIS, PC A03/MF A01.

The Radiation Advisory Committee of the Science Advisory Board has completed its review of the Office of Drinking Water's evaluation of radionuclides in drinking water and four draft criteria documents that support the evaluation, including Man-Made Radionuclide Occurrence, Radium, Radon and Uranium. The Committee addressed four issues: the weighting factors to be used in effective dose-equivalent calculations, the chemical toxicity and radiotoxicity of uranium, the linearity of the dose-response curve for naturally occurring radionuclides, and the appropriate use of the relative and absolute-risk models. The Subcommittee concludes that the Office of Drinking Water has developed scientifically comprehensive assessment documents.

1824 **(WHC-EP—0142-1) Ground-water maps of the Hanford Site Separations Area, June 1988.** Schatz, A.L.; McElroy, M.D. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1988. Contract AC06-87RL10930. 12p. NTIS, PC A03/MF A01. Order Number DE89002141/JAW.

The ground-water maps of the Separations Area are prepared by the Environmental Engineering and Technology Function of the Environmental Division of Westinghouse Hanford Company (Westinghouse Hanford). The Separations Area consists of the 200 East and 200 West Areas, where chemical processing activities are carried out by Westinghouse Hanford for the US Department of Energy-Richland Operations Office (DOE-RL), and the surrounding area that may be impacted by operations. This set of ground-water maps consists of a water-table map and a depth-to-water map of the unconfined aquifer. The Separations Area water-table map is prepared semiannually from water-level measurements made in June and December. For the June 1988 map, approximately 190 wells were used for contouring the water table. The water-table mound beneath the deactivated U-Pond continues to decrease in size. This reflects the impact of shutting off flow to the pond in the fall of 1984. During the period from December 1987 to June 1988, the mound decreased slightly. This mound has had an overall decline of approximately 8 ft since 1984. The water-table map also shows the locations of wells where the June 1988 measurements were made, and the data for these measurements are listed. 1 tab.

1825 **(WHC-EP—0161) Westinghouse Hanford Company environmental surveillance annual report: 100 Areas, calendar year 1987.** Perkins, C.J. (Westinghouse Hanford Co., Richland, WA (USA)). Jul 1988. Contract AC06-87RL10930. 99p. NTIS, PC A05/MF A01. Order Number DE89001896/JAW.

Near-field environmental surveillance of the Hanford 100 Areas is performed by Westinghouse Hanford Company (Westinghouse Hanford) to assess and control the impacts of operations. This involves sampling and analysis from the major environmental pathways of exposure to onsite workers. Results from the Westinghouse Hanford Environmental Surveillance program for the Hanford 100 Areas are presented in this report. The environmental surveillance program provides sampling and monitoring of several parameters to evaluate the environmental impact of 100-N Area Reactor Facilities and the shutdown reactor facilities and burial grounds in the retired 100 Areas. Discharges to the environment are reported in annual effluent release reports. At 100-N Area, samples of ambient air, groundwater, vegetation, and surface soil were collected and analyzed. Direct radiation levels were also monitored at several locations. Samples of ambient air, vegetation, surface soil, and sediment were collected to monitor the environmental impact of the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDFs). Direct radiation surveys were conducted for each LWDF and along the Columbia River shoreline. At the retired 100 Areas, vegetation and surface soil samples were collected and analyzed. In addition, samples from groundwater monitoring wells located at 100-K Area were collected and analyzed. The results provided in this report are summarized by highlights. 23 refs., 22 figs., 21 tabs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 222, 396, 397, 1709, 1756, 1757

1826 (CONF-871075—Vol.1-Pt.2, pp 309-320) **Enhanced volatilization for removal of hazardous waste from soil.** Payne, F.C. (Midwest Water Resource, Inc., Charlotte, MI (USA)). 1987. NTIS, PC A17/MF A01. Order Number DE88007804/JAW.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

Soils in the unsaturated (vadose) zone are frequently found to be reservoirs of ground water contaminant materials at hazardous waste sites. Many of the contaminants at these sites have vapor pressure levels at soil temperatures which allow their removal by enhanced volatilization, or EV procedures. EV processes generally remove solvent-laden air from soils, depending upon evaporation of the target materials to drive the process. MWRI has conducted enhanced volatilization removal of many hazardous waste compounds including chlorinated solvents (PERC and TCE), aromatic ring compounds (benzene, toluene, xylenes, ethylbenzene) and other cyclic and non-cyclic carbon compounds (eg. ketones, naptha, mineral spirits, lacquer diluter). The author's experience indicates that removal of soil volatiles to levels which yield an aqueous phase equilibrium concentration t or below Federal drinking water standards is a realistic treatment objective. Their data shows that these levels can be reached within 3 to 6 months for most sites at costs roughly 10% of excavation and landfilling. Applicability of EV is determined by pneumatic conductivity of soils, vapor pressure of target compounds at soil temperature and off-gas control capability. Most importantly, EV can be adapted to recover volatiles from mixed wastes.

1827 **(PB—88-235759/XAB) Fiscal Year 1987 program report: North Carolina Water Resources Research Institute.** (North Carolina Water Resources Research Inst., Raleigh (USA)). May 1988. 29p. NTIS, PC A03/MF A01.

See also report for 1987, PB—87-217402.

The major thrust of the Water Resources Research Institute during the 1987 program year involved activities related to its research and technology-transfer program. Surface and ground-water quality and watershed protection problems are the top priority issues in the state. Research projects funded by the Institute to address these problems and issues included: the problem of developing better technology to document the specific sources of nitrogen in surface water experiencing nuisance blue-green algal growth; the role of wetlands in removing nutrients from streams receiving wastewater discharges; the development and testing of a simulation model that can be used to analyze the performance of stormwater infiltration ponds in the coastal area; and the development and implementation of the Institute information materials, response to requests for information, development of conferences, workshops and seminars, publication of conference proceedings, and the review and publication of research reports.

5206 Regulations

REFER ALSO TO CITATION(S) 196, 706, 711, 1712, 1765, 1823

1828 **(AD-A—196072/3/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 38, Porter, New York, RCRA (Resource Conservation and Recovery Act) sites. Final report, September 1986-February 1988.** (Ecology and Environment, Inc., Lancaster, NY (USA). Buffalo Corporate Center). Apr 1988. 305p. NTIS, PC A14/MF A01.

Ecology and Environment, Inc., was retained by the USAFOEHL/TSS to provide technical and analytical services in support of the Air Force IRP. These services were supplied for the Phase II, Stage 1 investigation at Air Force Plant 38 (AFP 38), Porter, NY. The field investigation was conducted between 30 September 1986 and 8 October 1986, and involved work at seven sites. Two of the sites fell under RCRA jurisdiction and are described in a separate report. The investigation included record searches and sampling of surface and subsurface soils and surface water. Samples were analyzed for various parameters including metals, volatile organics, TOC, TOX, petroleum hydrocarbons, fluorides, nitrates, hydrazine, and isopropyl alcohol. Results of the investigation indicated that four of the five sites had only minor amounts of contamination present and have, therefore, been recommended for no follow-up action. The on-site fuel-storage tanks and transformers were recommended for removal, according to applicable standards and regulations.

1829 **(AD-A—196073/1/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 1. Air Force Plant 38, Porter, New York. Final report, September 1986-February 1988.** (Ecology and Environment, Inc., Lancaster, NY (USA). Buffalo Corporate Center). Apr 1988. 35p. NTIS, PC A03/MF A01.

Ecology and Environments, Inc., was retained by the USAFOEHL/TSS to provide technical and analytical services in support of the Air Force IRP. These services were supplied for the Phase II, Stage 1 investigation at Air Force Plant 38 (AFP 38), Porter, NY. The field investigation was conducted between 30 September 1986 and 8 October 1986, and involved work at seven sites. Two of the sites fell under RCRA jurisdiction. The investigation at these two sites included record searches, sampling of subsurface soils, and surface samples from two concrete pads. Samples were analyzed for various parameters including TOC, TOX, petroleum hydrocarbons, hydrazine, metals, volatile organics, and isopropyl alcohol. Results of the investigation indicated that both sites had contamination present. One site required additional work to better determine the extent of contamination and was recommended for Phase III work. The second site contained higher levels of contamination and was recommended for Phase IV (remediation) work.

1830 **(AD-A—196293/5/XAB) Coordinate transformation model for overlap distribution: an application to groundwater protection. Master's thesis.** Robinson, T.G. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1988. 106p. (AFIT/CI/NR—88-9). NTIS, PC A06/MF A01.

Taylor (1977) suggests that source protection is the first line of defense in assuring drinking water quality. The intent of protective measures is to reduce or eliminate human activities that utilize substances that pose a potential contamination threat to the water source. The primary aim of the water-supply industry has been to ensure that the consumer is provided with water which is free from pathogenic microorganisms. In spite of these incidences of bacteriological contamination, the major public concern with drinking

water has been possible contribution to cancer risks due to chemical pollutants.

1831 **(PB—88-235791/XAB) Advisory system for North Carolina ground water quality modeling and management needs.** Medina, M.A.; Butcher, J.B.; Marin, C.M. (North Carolina Water Resources Research Inst., Raleigh (USA)). Feb 1988. 227p. (UNC-WRRI—88-236). NTIS, PC A11/MF A01.

Federal policy states that ground-water quality management is a state responsibility. Waste disposal sites that discharge or may leak to a ground-water system must undergo a permitting process. Applications are reviewed by the Division of environmental Management, Department of Natural Resources and Community Development, State of North Carolina. The research project conditions the permitting process upon: sound mathematical-modeling techniques, review of all sources of data on waste, method of disposal and hydrogeologic scenario -- all processed by a computerized advisory system capable of assessing degree of uncertainty within a sequential decision analysis framework. The advisory system is a friendly, interactive menu-driven management program which executes a large number of supporting decision algorithms and mathematical models, including 3-dimensional color graphics representation of the predicted contaminant plume. A user's manual is presented.

1832 **(PB—88-236641/XAB) Storm-Water Management Model, Version 4. Part a: user's manual.** Huber, W.C.; Dickinson, R.E. (Florida Univ., Gainesville (USA). Dept. of Environmental Engineering Sciences). Jun 1988. 597p. NTIS, PC A25/MF A01.

See also PB—84-198423 and PB—88-236658.

The EPA Storm-Water Management Model (SWMM) is a comprehensive mathematical model for simulation of urban runoff water quality and quantity in storm and combined sewer systems. All aspects of the urban hydrologic and quality cycles are simulated, including surface and subsurface runoff, transport through the drainage network, storage and treatment. Part A of the two-volume report is an update of the user's manuals issued in 1971, 1975, and 1981. Part B is a user's manual for EXTRAN, a flow-routing model that can be used both as a block of the SWMM package and as an independent model. The SWMM user's manual provides detailed descriptions for program blocks for Runoff, Transport, Storage/Treatment, Combine, Statistics, Rain, Temp and Graph (part of the Executive Block). EXTRAN represents a drainage system as links and nodes, allowing simulation of parallel or looped-pipe networks; weirs, orifices, and pumps; and system surcharges.

1833 **(PB—88-236815/XAB) Water quality in Iowa during 1986 and 1987.** (Iowa Dept. of Natural Resources, Des Moines (USA). Environmental Protection Div.). 1 Apr 1988. 158p. NTIS, PC A08/MF A01.

See also PB—87-179578.

This report presents the results of the water-quality monitoring, assessment, and control programs conducted in Iowa during 1986 and 1987. It was prepared to satisfy Section 305(b) of the Clean Water Act (CWA) which requires biennial water-quality reporting by each state. Discussions in the report include the following topics: surface-water quality, public health and aquatic life concerns, ground-water quality, special state concerns, point-source control programs, lake pollution-control programs, nonpoint source control programs, state program costs, surface-water monitoring programs, intensive water surveys, and DNR recommendations to EPA. A new requirement of the CWA addresses impairment of water bodies due to toxic and conventional pollutants. The section is addressed in detail in the report.

1834 **(PB—88-238951/XAB) Applicability of US EPA (Environmental Protection Agency) risk-assessment guidelines for chemical mixtures.** Lutkenhoff, S.D.; Hertzberg, R.C.; Sonich-Mullin, C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Aug 1988. 35p. (EPA—600/D-88/170). NTIS, PC A03/MF A01.

The U.S. EPA published Guidelines for the health Risk Assessment of Chemical Mixtures in September, 1986. To facilitate the application of Guidelines procedures, the Agency has developed a data base on known toxicological interactions (synergism, etc.). This unique resource allos incorporation of interaction data on a case-by-case basis into mixture risk assessments. Additional technical support information is being compiled, which will provide the scientific basis for the Guidelines procedures. In the present paper, the Guidelines still be summarized and illustrated using an example assessment of contaminated ground water.

1835 **(PB—88-239173/XAB) EPA (Environmental Protection Agency) Region X guidance manual for the development of an accidental-spill prevention program.** (Science Applications International Corp., McLean, VA (USA)). Feb 1986. 164p. NTIS, PC A08/MF A01.

This document was prepared for EPA Region X to assist publicly owned treatment works (POTWs) in implementing a component of their Pretreatment Program, namely the prevention of accidental spills and slug discharges from industrial users. Such spills and slug discharges could cause damage to a POTW's collection system, interfere with the operation or its treatment plant, affect water quality and sludge usage, and potentially affect worker health and safety. The important elements of an accidental-spill prevention program include the following: identification of potential sources and risks, evaluation and/or development of legal authority to regulate spills and slug discharges, requirements for industrial users to develop Accidental Spill Prevention Program plans and submit them to the POTW for review, inspection, and monitoring of potential sources of problem discharges, development of emergency procedures, and resources.

1836 **(PB—88-241211/XAB) Alternate Concentration Limit Guidance: final draft. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 24 Oct 1986. 7p. (SAB/EEC—87/003). NTIS, PC A02/MF A01.

The Environmental Engineering Committee conducted a preliminary review of the above document in March 1986, and identified obvious errors or omissions which are explained in detail in its initial report. The Office of Solid Waste asked the Committee to review the final draft ACL guidance when it was ready for publications in the Federal Register. This report represents the Committee's review of the final draft which was found to be well-written and technically sound.

1837 **(PB—88-241732/XAB) Citizen's guide to coastal water resource management.** Kennedy, J.; Miller, T. (North Carolina Coastal Federation, Inc., Newport (USA)). 1988. 92p. NTIS, PC A05/MF A01.

Also pub. as North Carolina State Univ. at Raleigh. Sea Grant College Program rept. no. UNC/SG-88/05.

Contents include: taking the initiative; water-quality standards; Coastal Area Management Act; dredge-and-fill permits under Section 404; sediment and erosion control; other environmental laws; nonregulatory ways to help protect water resources.

1838 **(PB—88-242706/XAB) EPA's (Environmental Protection Agency's) draft drinking-water criteria document for monochlorobenzene. Technical comments of the Halogenated Organics Subcommittee. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 16 Jan 1987. 10p. (SAB/EHC—87/020). NTIS, PC A02/MF A01.

The Halogenated Organics Subcommittee evaluated the animal evidence for carcinogencity of chlorobenzene to be inadequate under EPA's new guidelines based on the lack of a statistically significant increase in the incidence of tumors in female mice, male mice and female rats, and on the basis of the perception of a diminished biologic significance of reported malignant neoplastic nodules of the liver in the highest dose-treated male rats. The evidence would place chlorobenzene into the overall weight-of-the-evidence category D (not classified).

1839 **(PB—88-243407/XAB) Review of technical documents supporting proposed revisions to EPA (Environmental Protection Agency) regulations for the disposal/reuse of sewage sludge under Section 405(D) of the Clean Water Act. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). Jan 1987. 82p. (SAB/EEC—87/015). NTIS, PC A05/MF A01.

In August 1985 the Environmental Engineering Committee of the Science Advisory Board was asked by the Office of Water Regulations and Standards (OWRS) to review technical documents supporting development of EPA regulations for the disposal/reuse of sewage sludge under Section 405(d) of the Clean Water Act. The Committee was also asked by the Office of Marine and Estuarine Protection (OMEP) to review technical documents supporting revisions of the EPA ocean dumping regulations. The Committee chose to review the two sets of documents together, since they both dealt with a common subject, and since they shared, in some respects, a common methodology. The report, however, covers only the review of the OWRS documents, which consist of a set of risk-assessment methodologies (1,2,3,4) for four sludge disposal/reuse options (landfilling, land application/distribution and marketing, incineration, and ocean disposal). The reviews of the OMEP documents are covered in separate Committee reports. The Committee's principal findings are outlined.

1840 **(PB—88-243712/XAB) Science advisory board review of the water quality criteria document for dissolved oxygen. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). Apr 1986. 28p. (SAB/EETFC—86/020). NTIS, PC A03/MF A01.

See also PB—86-208253.

Six major scientific issues to be assessed include: the invertebrate problem; laboratory-field implications; additive stresses and chemical interactions; growth-rate reductions; oxygen criteria levels; and dissolved-oxygen monitoring conditions. The document is well-organized and researched. Logic and conclusions are scientifically defensible.

1841 **(PB—88-244728/XAB) Review of technical documents supporting revisions to the portion of EPA (Environmental Protection Agency) ocean-dumping regulations relating to the ocean disposal of dredged materials. Report of the Environmental Engineering Committee. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 14 Jan 1987. 19p. (SAB/EEC—87/014). NTIS, PC A03/MF A01.

Although the Committee is in agreement with the EPA that there are significant differences in the properties of most sewage sludge and dredged materials, significant exceptions exist. Clearly defined, consistent, rigorous, and peer-reviewed procedures must exist to identify these exceptions. The EPS Office of Marine and Estuarine Protection maintains that existing procedures for evaluating dredged materials (under Part 227.13) are adequate; however, based on the documents provided to the Committee, a rigorous protocol for identifying exceptions do not appear to exist.

1842 **(SNV—3324) Plans of action for performance of international conventions. Part 5. Background data for 'Plan of action against sea pollutants'.** (National Swedish Environmental Protection Board, Solna). Jun 1987. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755079/JAW.

In August 1986 the Swedish government appointed an action committee against sea pollution. At the request of the committee, the National Swedish Environment Protection Board presented a plan of action in May 1987. The report is one of five appendices to the plan. Main headings of the report: Plans of action for -Helsinki convention, -Paris convention, -North Sea Conference, -Gulf of Bothnia Committee -The Sound Commission.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 822

1843 **Farm location and off-farm employment: an analysis of spatial risk strategies.** Jones, D.W. (Oak Ridge National Lab., TN (USA)). *Institute of British Geographers, Transactions;* **9**: 106-123(1984).

Taking off-farm employment is one option a farmer has to diversify his income sources and reduce the riskiness of his income. The benefits from, and costs of, off-farm employment have distinct spatial patterns which are derived from the Thuenen model of land pricing. The benefits increase, most likely at a decreasing rate, as distance from markets increases. There are two cost components, a commuting cost which always increases with distance from markets, and an on-farm opportunity cost, which always decreases as distance increases. The spatial pattern of the equilibrium off-farm employment first shows an increase over distance, then a decrease. Other options that farmers have to disperse risk are crop diversification and farm tenure choice. Complementarity and substitution relationships among these options are discussed, and the off-farm employment model is used to reconcile spatial patterns of crop diversification and share-cropping in the Northern US in 1880. Indirect evidence from India from 1954 to 1971 also supports the predictions of the model. 11 references, 6 figures, 1 table.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 706

1844 **(EIS—88-0004(Draft)) Special isotope separation project, Idaho National Engineering Laboratory, Idaho Falls, Idaho.** (USDOE, Washington, DC). Feb 1988. 350p. (DOE/EIS—0136D). EIS, Digest of Environmental Impact Statements, 7200 Wisconsin Ave., Bethesda, MD 20814.

EPA No. 880041D; DOE.

Construction and operation of a Special Isotope Separation (SIS) project using the Atomic Vapor Laser Isotope Separation (AVLIS) process technology at the Idaho National Engineering Laboratory (INEL) near Idaho Falls, Idaho are proposed. The SIS project would process fuel-grade plutonium administered by the Department of Energy (DOE) into weapon-grade plutonium using AVLIS and supporting chemical processes. The SIS project would require construction and operation of a Laser Support Facility to house the laser system and a Plutonium Processing Facility. The SIS project would be integrated with existing support and waste management facilities at the selected site. The SIS project would provide DOE with the capability of segregating the isotopes of DOE-owned plutonium into specific isotopic concentrations. This capability would provide redundancy in production capacity, technological diversity, and flexibility in DOE's production of nuclear materials for national defense. Use of the INEL site would impact 151,350 square meters (37.4 acres) of land, of which more than 70% has been previously disturbed. During construction, plant and animal habitat associated with a sagebrush vegetation community would be lost. During operation of the SIS facilities, unavoidable radiation exposures would include occupational exposures and exposures to the public from normal atmospheric releases of radioactive materials that would be minimal compared to natural background radiation.

1845 **(PB—88-868856/XAB) Environmental impacts: computer analysis. January 1970-September 1988 (Citations from the NTIS data base). Report for January 1970-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 261p. NTIS PC N01/MF N01.

Supersedes PB—87-867081.

This bibliography contains citations concerning the utilization of computerized methods in the analysis of environmental impacts related to a variety of human activities. Topics include de-

scriptions and evaluations of specific simulation programs, site analyses, and the employment of computer equipment in environmental data analysis. Plume migration in water and air pollution studies, and the analysis of aquatic and terrestrial ecosystems are among the applications considered. (This updated bibliography contains 395 citations, 36 of which are new entries to the previous edition.)

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 1865, 1874, 1899, 1920

1846 **(AD-A—195782/8/XAB) Immunological techniques for detection of fungal and dinoflagellate toxins. Annual report, 1 May 1987-30 April 1988.** Chu, F.S. (Bundesministerium fuer Wirtschaftliche Zusammenarbeit, Bonn (Germany, F.R.)). 12 May 1988. 22p. NTIS, PC A03/MF A01.

1) A new direct ELISA, which involves the use of a generic type antibody for T-2 toxin and 3-acetyl-neosolaniol-hemisuccinate (3-Ac-NEOS-HS) conjugated to horseradish peroxidase for the analysis of T-2 toxin metabolites, was established. 2) Analysis of 5 metabolites, i.e., T-2 toxin, HT-2, T-2-4ol, 3'-OH-HT-2, NEOS and a mixture of these five toxins, added at toxin concentrations of 50 and 200 ng/mL of urine, revealed that 87% of the added toxins were recovered analytically at both concentrations in the ELISA, and 69% in RIA and the 200 ppb level. 3) A series of monkey urine samples obtained from a metabolic study was subjected to the new ELISA protocol was as well as to RIA. 4) An extensive study to evaluate a fluorometric method, i.e., hit-and-run assay was made. 5) A direct ELISA for deoxynivalenol (DON) was established. 6) Further improvements for the ELISA for saxitoxin were made. 7) New approaches to produce antibody against nivalenol and saxitoxin were made, but the antibody titers were low. 8) Antibody against microcystin (MCS) was obtained from rabbits after immunizing the animals with MCS-BSA conjugate. 9) A chemical method for the preparation of different monoacetoxyscirpenol (MAS) was established. 10) Routine preparation of different immunochemical reagents continued. Phytotoxins Biological warfare agents; Dinoflagellates. (AW)

1847 **(AD-A—195868/5/XAB) Quaternary anticholinesterase therapeutics. Annual report, 22 July 1986-21 July 1987.** Harris, R.N.; Koolpe, G.A.; Lovejoy, S.M.; Kelson, A.B.; Vu, H.M. (SRI International, Menlo Park, CA (USA)). Apr 1988. 103p. NTIS, PC A06/MF A01.

Ninety-five new imidazolium, pyridinium, and 1,2,4-triazolium salts were prepared, characterized, and submitted to WRAIR for in-vivo evaluation as antidotes against the nerve agent soman. Many of the salts were evaluated at the U.S. Army Institute of Chemical Defense (ICD) in the mouse as treatment therapeutics for organophosphonate nerve agent intoxication. Of the effective type I compounds, those that provided the greatest protective ability incorporated side chains functionalized with nitro, sulfone, and amino groups. In an effort to prepare type I and II compounds that have the potential to reactivate aged, inhibited acetylcholinesterase by means of a chelated metal ion, several new phosphatase simulant ligands were prepared and characterized. Unfortunately, the ligands could not be induced to form stable metal complexes. Finally, a methodology for preparing 4(5)-substituted imidazoles was established and subsequently applied to the preparation of several new 4(5)-substituted type I salts.

1848 **(AD-A—196922/9/XAB) US Army Medical Materiel development activity, 1987 annual report. Progress report, 1 January-31 December 1987.** Pedersen, C.E. (Army Medical Materiel Development Agency, Fort Detrick, MD (USA)). 6 May 1988. 56p. NTIS, PC A04/MF A01.

Information relating to accomplishments in military medicine in three areas is presented. The Project Management Support Division (PMSD) provides centralized administrative, financial management, contracting, and logistical support to the Project Managers and staff. The Biological Systems Project Management Division manages the development and acquisition of biological products to prevent casualties or loss of soldier effectiveness due to disease. These diseases may be naturally acquired (close contact, unsanitary conditions, contaminated environment, biting insects), or delivered deliberately (aerosols). Product Officers exploit domestic and foreign medical technology to remedy deficiencies identified by the Combat Developer and monitor research projects for their application to disease protective measures. The Pharmaceutical Systems Project Management Division centrally manages the development and the initial production of pharmaceutical products (antidotes and drugs), related drug delivery systems (autoinjectors and transdermal patches), and decontamination products. These products are fielded as preventive, protective, and therapeutic modalities for use against chemical and biological warfare threats, certain endemic diseases, and the treatment of combat casualties. The Applied Medical Systems Project Management Division is a multidisciplinary team with broad mission responsibilities to centrally manage the development and initial production of applied medical products, related diagnostic equipment, optical corrective devices for protective masks, and pesticide delivery systems.

1849 **(AD-A—197010/2/XAB) Assessment of neurological effects of drugs on oculomotor and visual function in the primate. Annual report, September 1981-August 1982.** Keating, E.G. (State Univ. of New York, Syracuse (USA). Upstate Medical Center). 10 Dec 1982. 21p. NTIS, PC A03/MF A01.

A number of cholinergic agents are deemed useful as prophylactics or antidotes to organophosphate poisoning, yet have their own toxic effects. Dosages of these agents which are known to not grossly disrupt behavior may nonetheless degrade performance of sophisticated tasks required of the personnel of a modern mechanized army. The contract uses on animal model (primate) to assess the effects of cholinergic drugs on the performance of visual search and tracking tasks which mimic skills generally used in the field. The eye movements of cynomolgous monkeys (Macaca fascicularis) were recorded with the magnetic search coil technique while they searched for camouflaged visual targets. To date the research has defined the normal patterns of eye movements of monkeys engaged in visual search and there are preliminary results describing the effects of physostigmine and pralidoxime. Only at the highest dose did physostigimine consistently degrade eye movements and impair visual search. The deficit was a subtle one and was primarily an oculomotor effect rather than a motivational, visual, or cognitive impairment. Pralidoxime also had no consistent effect at any but the highest dose. Behavioral testing was erratic at this dose but visual search was successful when attempted at all by the monkey, suggesting a motivational rather than specifically oculomotor impairment.

1850 **(LA-UR—88-2954) Isolation and partial sequence of the A-protein gene of Thermus thermophilus cytochrome c_1aa_3.** Fee, J.A.; Mather, M.W.; Springer, P.; Hensel, S.; Buse, G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-8806246—1). NTIS, PC A03/MF A01. Order Number DE89000374/JAW.

From Conference on cytochrome oxidase: structure, function, and physiopathology; Rome, Italy (20 Jun 1988).

Thermus thermophilus is a strictly aerobic eubacterium which grows optimally near 70{degree}C. Its respiratory system is very similar to that of eukaryotic mitochondria, and the organism has proven to be a particularly good source of stable, comparatively simple respiratory enzymes. There are at least two terminal oxidases: The recently discovered cytochrome ba_3[3] and cytochrome c_1aa_3[2]. Cytochrome ba_3 is analog of aa_3 in which the heme A of cytochrome a is replaced with protoporphyrin IX (heme B) while its order redox components appear to be largely identical to those of the now classical mammalian cytochrome aa_3; it has only a single 35 kD protein subunit. Cytochrome c_1aa_3 consists of two polypeptides. The {approximately}33 kD C-protein covalently binds one heme C, while the {approximately}55 kD protein is thought to bind the four canonical redox centers of aa_3, two heme A, and two Cu. Toward our goal of unequivocally establishing the distribution

of the metal centers in cytochrome c_1aa_3, we have isolated the structural gene of the A-protein. 20 refs., 4 figs.

1851 **(LBL—25747) Temperature dependent steady state and picosecond kinetic fluorescence measurements of a photosystem I preparation from spinach.** Mukerji, I.; Sauer, K. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 29p. (CONF-8807124—1). NTIS, PC A03/MF A01. Order Number DE89001257/JAW.

From C.S. French symposium; Stanford, CA, USA (18 Jul 1988).

The fluorescence properties of a photosystem I (PSI) preparation from spinach containing approximately 200 chlorophyll (Chl) per reaction center were investigated. The preparation, characterized both spectroscopically and biochemically, contained the peripheral light harvesting antenna associated with PSI. In this study steady state fluorescence measurements were performed as a function of temperature. An emission maximum at 690 nm and a long wavelength shoulder from 710 to 740 nm were observed. The fluorescence yield at 690 nm is temperature independent, while the yield of the long wavelength shoulder increases dramatically with decreasing temperature. Additionally, kinetic measurements using the technique of single photon counting were done at room temperature and 77K. At 295K a four component fit was needed to describe the fluorescence decay; whereas at 77K, an additional 40-50 ps rise component indicative of fluorescence induction was necessary. 28 refs., 13 figs., 1 tab.

1852 **(PB—88-233937/XAB) Simplifying complex QSAR's (quantitative structure-activity relationships) in toxicity studies with multivariate statistics.** Niemi, G.J.; McKim, J.M. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). Jul 1988. 13p. (EPA—600/D-88/142). NTIS, PC A03/MF A01.

During the past several decades many quantitative structure-activity relationships (QSAR's) have been derived from relatively small data sets of chemicals in a homologous series and selected empirical observations. An alternative approach is to analyze large data sets consisting of heterogeneous groups of chemicals and to explore QSAR's among these chemicals for generalized patterns of chemical behavior. The use of exploratory multivariate statistical techniques for simplifying complex QSAR problems is demonstrated through the use of research data on biodegradation and mode of toxic action. In these examples, a large number of explanatory variables were examined to explore which variables might best explain whether a chemical biodegrades or whether a toxic response by an organism can be used to identify a mode of toxic action. In both cases, the procedures reduced the number of potential explanatory variables and generated hypotheses about biodegradation and mode of toxic action for future research without explicitly testing an existing hypothesis.

1853 **Isolation and complementation of mutants of Anabaena sp. strain PCC 7120 unable to grow aerobically on dinitrogen.** Wolk, C.P.; Cai, Y.; Cardemil, L.; Flores, E.; Hohn, B.; Murry, M.; Schmetterer, G.; Schrautemeier, B.; Wilson, R. (Michigan State Univ., East Lansing (USA)). *Journal of Bacteriology;* **170**: No. 3, 1239-1244(Mar 1988).

Mutants of Anabaena sp. strain PCC 7120 unable to grow aerobically on dinitrogen were isolated by mutagenesis with UV irradiation, followed by a period of incubation in yellow light and then by penicillin enrichment. A cosmid vector, pRL25C, containing replicons functional in Escherichia coli and in Anabaena species was constructed. DNA from wild-type Anabaena sp. strain PCC 7120 was partially digested with Sau3AI, and size-fractionated fragments about 40 kilobases (kb) in length were ligated into the phosphatase-treated unique BamHI site of pRL25C. A library of 1054 cosmid clones was generated in E. coli DH1 bearing helper plasmid pDS4101. A derivative of conjugative plasmid RP-4 was transferred to this library by conjugation, and the library was replicated to lawns of mutant Anabaena strains with defects in the polysaccharide layer of the envelopes of the heterocysts. Mutant EF116 was complemented by five cosmids, three of which were subjected to detailed restriction mapping; a 2.8-kb fragment of DNA derived from one of the cosmids was found to complement EF116. Mutant EF113 was complemented by a single cosmid, which was also restriction mapped, and was shown to be complemented by a 4.8-kb fragment of DNA derived from this cosmid.

1854 **Electrophoretic extraction of proteins from two-dimensional electrophoresis gel spots.** Zhang, Jian-Shi; Giometti, C.S.; Tollaksen, S.L. US Patent Application 6-092,924. 4 Sep 1987. 45p. Contract W-31109-ENG-38. NTIS, PC A03/MF A01.

After two-dimensional electrophoresis of proteins or the like, resulting in a polyacrylamide gel slab having a pattern of protein gel spots thereon, an individual protein gel spot is cored out from the slab, to form a gel spot core which is placed in an extraction tube, with a dialysis membrane across the lower end of the tube. Replicate gel spots can be cored out from replicate gel slabs and placed in the extraction tube. Molten agarose gel is poured into the extraction tube where the agarose gel hardens to form an immobilizing gel, covering the gel spot cores. The upper end portion of the extraction tube is filled with a volume of buffer solution, and the upper end is closed by another dialysis membrane. Upper and lower bodies of a buffer solution are brought into contact with the upper and lower membranes and are provided with electrodes connected to the positive and negative terminals of a dc power supply, thereby producing an electrical current which flows through the upper membrane, the volume of buffer solution, the agarose, the gel spot cores and the lower membrane. The current causes the proteins to be extracted electrophoretically from the gel spot cores, so that the extracted proteins accumulate and are contained in the space between the agarose gel and the upper membrane. 8 figs.

1855 **Conformational changes in the 16S rRNA induced by ribosomal proteins in the assembly process of the 30S E. coli subunit.** Mandiyan, V.; Wall, J.S.; Hainfeld, J.F.; Boublik, M. (Roche Institute of Molecular Biology, Nutley, NJ (USA)). *Plant Physiology, Supplement;* **46**: No. 6, 2219(1 May 1987). (CONF-870644—).

From 78. annual meeting of the American Society of Biological Chemists conference; Philadelphia, PA, USA (7 Jun 1987).

Conformational changes induced in the 16S rRNA by interactions with ribosomal proteins S4, S8, S15, S17, and S20, were monitored by scanning transmission electron microscopy (STEM) and CD spectroscopy with the aim to clarify the mechanism of rRNA folding during the ribosome assembly. The RNA-protein complexes were prepared by the standard reconstitution procedure and were dialyzed against 60mM KCl, 2mM $Mg(OAc)_2$, 10mM Hepes-KOH, pH 7.5. In most combinations the protein binding induced folding of the 16S rRNA into more compact forms evident from the values of radii of gyration, calculated from the mass distribution within the RNA-protein complexes. The most significant conformational changes were observed in the complex of 16S rRNA with proteins S4, S8 and S15. However, even these particles did not show structural similarity to the complete 30S subunits. The CD spectra and melting profiles of the 16S RNA-protein complexes imply a similar net content of ordered secondary structure of 16S RNA but differences in its distribution. These results indicate that interactions of 16S rRNA with five ribosomal proteins involved in the initial steps of ribosome subunit assembly induce conformational changes but not to the same extent as in the complete 30S subunit.

1856 **Hydration-dependent phase transitions and permeability properties of biological membranes.** Crowe, L.M.; Crowe, J.H. pp 210-230 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Many carbohydrates can stabilize liposomes against fusion and against leakage during freeze drying. Trehalose, which is found in high concentration in anhydrobiotic organisms, is most effective against fusion, and it and maltose are most effective in preventing leakage during dehydration. Trehalose has also been found to drive down the T/sub m/ of vesicles of POPC and prevent phase separation of POPC and PS in homogeneous dry multilamellar preparations of a mixture of these phospholipids. A tentative interpretation of calorimetric data from lyophiiized liposomes suggests that the inner and outer monolayers of the vesicle wall are independent of each other with regard to phase changes when there is enough tre-

halose present outside the liposomes to prevent phase separation of POPC and PS in the outer monolayer. Trehalose may serve as a protectant against desiccation damage in anhydrobiotic organisms by suppressing phase separations and phase transitions in dry membranes. Such effects would lead to maintenance of integrity of membranes during rehydration.

1857 **Interaction of trehalose with the phospholipid bilayer: a molecular modeling study.** Gaber, B.P.; Chandrasekhar, I.; Pattabiraman, N. pp 231-241 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

There is now ample evidence that stabilization of organisms against dehydration is, at least in part, a membrane phenomenon. In particular the interaction of the membrane with water and with small molecules which can, in some way, substitute for water seems to be critical to our understanding of anhydrobiotic processes at a molecular level. Their approach to studying interactions involving membranes, water, and small molecules is to use computer modeling techniques to display accurate graphical representations of phospholipids and the bilayers they form, to model the interactions both graphically and by molecular mechanics, and ultimately to model the molecular dynamics of the processes involved. They authors have attempted to represent lipid molecules and the bilayer in a new light in which the structures are accurate representations of the physical chemistry of the molecules. The objective of this effort is to produce a model which is a more realistic guide to their thinking about the nature of the phospholipid bilayer. However, once such a model has been established, they soon observe aspects of bilayer structure that would otherwise have remained obscure. Furthermore, a chemically and physically accurate bilayer model is an obligatory starting point for subsequent attempts at higher level molecular modeling.

1858 **Binding of water to dry biological systems.** Rupley, J.A.; Siemankowski, L. pp 259-272 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Structural and chemical studies on solutions and ordered preparations of proteins, nucleic acids, and membranes have given us a relatively full molecular-level understanding of many of their functions. Nevertheless there are weaknesses in their understanding of function, and arguably the most important is in the understanding of how water participates. There has not been general agreement on simple questions such as how much water is bound to a macromolecule or even what comprises bound water. One way of thinking about macromolecule hydration is in terms of two phases, macromolecule and water, and phase diagrams that describe the dependence of system properties on composition. As water is added incrementally to a sample of dry macromolecule, it dissolves in the macromolecule phase. The properties of this phase change with the composition of the system. At some point sufficient water will have been added to saturate the macromolecule, and there will be phase separation into fully hydrated macromolecule and bulk water. The problem is to describe as completely as possible the character of the interface between the macromolecule and bulk water. This interface extends into the water and into the macromolecule. It is necessary to describe the structure of the interface, the properties of the interface, and the extent of the interface.

1859 **Structural transitions induced by osmotic stress.** Parsegian, A.; Rau, D.; Zimmerberg, J. pp 306-317 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Biological materials suffering even a slight lowering of solvent water activity can undergo dramatic changes in organization and assembly. These transitions, viewed in the context of anhydrous biological systems, suggest to us that organisms adapted to transient extreme dryness might not only use protectants to prevent damage but might also preserve their vitality by undergoing intentional structural changes. The data on the systems to be mentioned below - sickle cell hemoglobin, DNA double helixes, lipid bilayers - have been well reported elsewhere and will be only briefly reviewed here. They will try to extract from those studies some idea of the kinds of stress that can be expected to produce structural reorganization inside a cell and to compare the magnitude of stresses seen in these measurements with those characteristic of strong dehydration. The strategy in their studies has been to create thermodynamically well defined changes in a system - usually by decreasing the activity of water but also by varying temperature, pressure, and the activity of liganding species that affect molecular assembly - and then to observe the structural consequences of these imposed thermodynamic changes. Proteins and nucleic acids can be driven to assemble, lipids can freeze their hydrocarbon chains, and transmembrane ionic channels can be forced to close. Both the prevention of these kinds of responses and their practical exploitation could be intentionally incorporated into the design of a cell forced to endure dehydration in its natural life.

1860 **Stabilization of small unilamellar phospholipid vesicles by sucrose during freezing and dehydration.** Strauss, G.; Hauser, H. pp 318-326 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Phospholipid bilayers constitute the fundamental structural element of biological membranes. Desiccation and rehydration at room temperature or freezing of cells, cell components, or plasma membranes have been reported to cause disruption of the membrane structure, resulting in the loss of membrane functions. In desiccation-tolerant organisms, membrane structure and functions appear to be retained in the presence of certain sugars. This observation prompted a systematic study of the stabilizing effect of sugars on phospholipid bilayers during freeze-thawing and dehydration-rehydration. The work presented here is addressed to the question of whether or not small unilamellar vesicles (SUV) made of phosphatidylcholine can be stabilized in the presence of sugar with full retention of their structural and permeability properties during freeze-thawing and freeze-drying. The work described here was carried out with SUV made by ultrasonication of egg phosphotidylcholine (EPC) dispersions in aqueous media with or without sucrose. The physical methods used here to monitor vesicle size and bilayer integrity comprise gel filtration on Sepharose 4B, dynamic light scattering, ^{1}H high-resolution NMR, freeze-fracture electro microscopy, and ESR spin labeling.

1861 **Comments on ^{31}P NMR.** Hauser, H. pp 347-349 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

The nonspherical distribution of electrons about the ^{31}P nucleus manifests itself in the anisotropy of the chemical shielding properties: the chemical shielding of this nucleus is orientation dependent and represented by a second-rank tensor. If a single crystal of a phosphate-containing compound is brought into the magnetic field of an NMR spectrometer, a single ^{31}P signal is observed. The magnetic field, or chemical shift, at which the ^{31}P signal occurs depends on the orientation of the single-crystal axes with respect to the magnetic field. The orientation of the principal axes of the ^{31}P chemical shielding tensor in phospholipids is unknown. The reason is that suitable single crystals of phospholipids required for the determination of the orientation of these axes have not been produced as yet.

1862 **X-ray diffraction as a technique for studying the mesomorphic phase properties of lipids.** Caffrey, M. pp 350-357 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

The authors describes the use of x-ray diffraction for lipid mesomorphic phase identification and phase transition temperature

determination. Some sample diffraction patterns, characteristic of the more commonly encountered lipid phases, such as the lamellar, ripple, hexagonal, cubic, and fluid isotropic phases, are included for reference purposes.

5503 Cytology

REFER ALSO TO CITATION(S) 1882, 1978

1863 (DOE/ER—0343, pp 195-198) **In vitro transformation of human fibroblasts.** Fry, D.G.; Hulin, P.; Ryan, P.A.; Wilson, D.M.; Maher, V.M.; McCormick, J.J. (Michigan State Univ., East Lansing (USA)). 1987. NTIS, PC A10/MF A01. Order Number DE88000256/JAW. (CONF-8706206—Sums.).

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

As part of the ongoing studies of malignant transformation of diploid human cells, it was found that normal human fibroblasts require either epidermal growth factor, platelet derived growth factor, fibroblast growth factor, or a medium lacking the above protein growth factors, but containing 1.0 mM calcium. No growth was observed in the 0.1 mM Ca medium without the addition of protein growth factors. Fibrosarcoma-derived human cell lines, spontaneously transformed human fibroblast cell lines and SV-40-transformed human fibroblast cell lines grew in the Ca medium without the addition of protein growth factors. Studies are underway to determine whether all transformed cells make specific growth factors. A technique is described for the transfection of oncogenes. Using the partially and malignantly transformed cells developed in these studies, assays are being developed for isolation of premalignant and fully malignant human cells.

5504 Genetics

REFER ALSO TO CITATION(S) 1922

1864 (CONF-8805172—Summ.) **Data management for physical mapping.** (National Inst. of General Medical Sciences, Bethesda, MD (USA); USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research; California Univ., San Francisco (USA). Howard Hughes Medical Inst.). Aug 1988. 15p. NTIS, PC A03/MF A01. Order Number DE88017239/JAW.

From Data management for physical mapping; Bethesda, MD, USA (12 May 1988).

It is time for the scientific community, including laboratory scientists, information specialists, administrators, professional societies, and journals, to clearly identify and address the problems of data management for the genome project. This report is intended to be a tool for opening the necessary discussions. It is not a comprehensive summary, a detailed plan of action, or a policy statement of any particular agency or group. Instead, it provides a foundation for additional discussions, meetings, workshops, and research. Creative solutions to the problems that exist are needed. Your ideas and participation are enthusiastically invited.

1865 (DOE/ER—0382) **The human genome initiative of the Department of Energy.** (USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). 1988. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88016888/JAW.

The structural characterization of genes and elucidation of their encoded functions have become a cornerstone of modern health research, biology and biotechnology. A genome program is an organized effort to locate and identify the functions of all the genes of an organism. Beginning with the DOE-sponsored, 1986 human genome workshop at Santa Fe, the value of broadly organized efforts supporting total genome characterization became a subject of intensive study. There is now national recognition that benefits will rapidly accrue from an effective scientific infrastructure for total genome research. In the US genome research is now receiving dedicated funds. Several other nations are implementing genome programs. Supportive infrastructure is being improved through both national and international cooperation. The Human Genome Initiative of the Department of Energy (DOE) is a focused program of Resource and Technology Development, with objectives of speeding and bringing economies to the national human genome effort. This report relates the origins and progress of the Initiative. 34 refs.

1866 (ORNL/TM—10853) **Environmental biotechnology of hazardous wastes research planning workshop, The National Science Foundation.** Sayler, G.S.; Blackburn, J.W.; Donaldson, T.L. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Center for Environmental Biotechnology). Aug 1988. Contract AC05-84OR21400. 34p. (CONF-8710395—Summ.). NTIS, PC A03/MF A01. Order Number DE89001340/JAW.

From Environmental biotechnology of hazardous wastes research planning workshop; Gatlinburg, TN, USA (30 Oct 1987).

Environmental biotechnology is "the direct use of microorganisms and their capabilities to solve environmental problems and for in-situ agricultural applications and industrial waste treatment." Environmental biotechnology is at the interface between responsible disciplines in engineering, molecular biology, and ecological sciences. The purpose of this research planning effort was to define limitations in the current knowledge base and to develop a research agenda and strategy that will lead to the successful practice of environmental biotechnology. The focus was specifically directed at environmental protection. However, it was recognized that the research plan typifies a central research model for the future development of effective and ecologically sound biotechnology for other environmental applications. 25 refs., 1 fig.

1867 (PNL—6500-Pt.1, pp 71-75) **Mutational studies in DNA targets.** Pelroy, R.A.; Fritz, L.K. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The authors have synthesized DNA targets, based on the primary sequences of known naturally occurring genetic hotspots, and placed then in the N-terminal region of the lac Z gene of the lactose operon of Escherichia coli. (The lactose operon was inserted into plasmid PDM, which was then introduced into Salmonella typhimurium.) The construction of the synthetic DNA targets prevents translation of the lac Z gene into β-galactosidase because of frameshift mutations that disrupt the reading frame for this structural gene. Mutations that reverse the synthetic mutations in the synthetic DNA targets and restore functionality to the lac Z gene can be scored by growth of S. typhimurium on lactose as the sole carbon source. Using this system, it is possible to detect mutational events within the DNA targets with great sensitivity, because a large number of bacteria can be exposed to a given mutagenic insult and because of the low background (spontaneous mutation rates) of these plasmid constructs.

1868 (SERI/SP—231-3331, pp 41-51) **Enzymatic and initial genetic studies on methanogens.** Ho, N.W.Y. (Purdue Univ., West Lafayette, IN (USA)). Jul 1988. NTIS, PC A 10. Order Number DE88001172/JAW.

In FY 1987 anaerobic digestion: Annual report.

Due to the extreme sensitivity to oxygen and unique physiology of the methanogens, it is exceedingly difficult to apply classical methodology to methanogens for their strain improvement. The recent advances in genetic engineering technology have made it possible to design new genetic approaches for the development of improved methanogens for methane generation. In order to apply this new technology to the methanogens, the construction of suitable cloning vectors for the transformation of the desired methanogens is essential. An effective cloning vector should contain at least two elements: a replication origin and a gene to serve as a selection marker. One of the efforts is to develop suitable selection markers for the establishment of transformation systems for the desired methanogens. Recently the author has been able to demonstrate that the bacterial kanamycin resistance gene can be an excellent selection marker for the development of transformation systems for some of the methanogens. Efforts have been made towards the construction of effective kanamycin resistance gene based cloning vectors for genetic engineering of the methanogens. 14 references, 8 figures.

1869 **(UCRL—99763) Potential DNA methods for measuring the human heritable mutation rate.** Mendelsohn, M.L. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 18p. (CONF-8808142—1). NTIS, PC A03/MF A01. Order Number DE89001432/JAW.

From 16. international congress of genetics; Toronto, Canada (20 Aug 1988).

Potential methods are reviewed for estimating human heritable mutation rates by comparing the DNA of parents and offspring. In the four years since the Alta Workshop on this subject, information has accumulated on several of the six methods detailed in that meeting. Some of the methods now appear to be infeasible, and all continue to be too inefficient for practical implementation. Newer DNA approaches are discussed, including several that could become practical enough for implementation. Finally, DNA-oriented methods using human sperm are considered as possible alternatives to the heritable approaches.

1870 **moxFG region encodes four polypeptides in the methanol-oxidizing bacterium Methylobacterium sp. strain AM1.** Anderson, D.J.; Lidstrom, M.E. (Univ. of Washington, Seattle (USA)). *Journal of Bacteriology;* **170**: No. 5, 2254-2262(May 1988).

The polypeptides encoded by a putative methanol oxidation (mox) operon of Methylobacterium sp. strain AM1 were expressed in Escherichia coli, using a coupled in vivo T7 RNA polymerase/promoter gene expression system. Two mox genes had been previously mapped to this region: moxF, the gene encoding the methanol dehydrogenase (MeDH) polypeptide; and moxG, a gene believed to encode a soluble type c cytochrome, cytochrome c/sub L/. In this study, four polypeptides of M/sub r/, 60,000, 30,000, 20,000, and 12,000 were found to be encoded by the moxFG region and were tentatively designated moxF, -J, -G, and -I, respectively. The arrangement of the genes (5' to 3') was found to be moxFJGI. The identities of three of the four polypeptides were determined by protein immunoblot analysis. The product of moxF, the M/sub r/-60,000 polypeptide, was confirmed to be the MeDH polypeptide. The product of moxG, the M/sub r/-20,000 polypeptide, was identified as mature cytochrome c/sub L/, and the product of moxI, the M/sub r/-12,000 polypeptide, was identified as a MeDH-associated polypeptide that copurifies with the holoenzyme. The identity of the M/sub r/-30,000 polypeptide (the moxJ gene product) could not be determined. The function of the M/sub r/-12,000 MeDH-associated polypeptide is not yet clear. However, it is not present in mutants that lack the M/sub r/-60,000 MeDH subunit, and it appears that the stability of the MeDH-associated polypeptide is dependent on the presence of the M/sub r/-60,000 MeDH polypeptide. Our data suggest that both the M/sub r/-30,000 and -12,000 polypeptides are involved in methanol oxidation, which would bring to 12 the number of mox genes in Methylobacterium sp. strain AM1.

5505 Metabolism

REFER ALSO TO CITATION(S) 15, 1876, 1894, 1981

1871 **Study of metabolism in dry seeds of Avena fatua L. evaluated by incubation with ethanol-1-^{14}C.** Lynch, R.M.; Clegg, J.S. pp 50-58 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

It has been proposed that any biological system whose water content has been reduced to 0.1 g water/g dry weight cannot carry out a metabolism. However, a number of published papers claim that metabolism is, indeed, occurring at this water content or even lower. The authors have reexamined this proposal and the results are reported.

1872 **Does trehalose play a role in yeast cells under stress?.** Panek, A.C.; Bernardes, E.; Panek, A.D. pp 123-142 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Accumulation of trehalose is a result of the activities of trehalose-6-phosphate synthase and of trehalase. Therefore, for studies of trehalose accumulation it is important to assess the activities of both enzymes. In wild type yeast the synthesizing activity predominates over the hydrolytic enzyme, which is normally found in a cryptic, inactive form, capable of being activated under certain physiological conditions. In an attempt to get a deeper insight into the role that trehalose plays when yeast cells are faced with different kinds of environmental or metabolic stresses, they have constructed diploid and haploid strains which harbor specific lesions in the regulation of the enzymes involved in trehalose metabolism. Sporulation, germination, and nutrient deprivation were the major parameters analyzed.

1873 **Physical properties and metabolic status of Artemia cysts at low water contents: the water replacement hypothesis.** Clegg, J.S. pp 169-187 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

In this paper the author considers what has come to be known as the water replacement hypothesis (WRH). The initial hypothesis was that polyhydroxyl compounds replace the structural water of cellular components as intracellular water levels are reduced, thereby preventing a variety of potentially lethal events from taking place. The hypothesis was formulated on the basis that many of the animals capable of reversible drying do, indeed, contain high concentrations of such polyhydroxyl compounds as glycerol, trehalose, and certain sugar alcohols. The real test of the WRH must come from studies on intact cells or organisms. In this paper he will summarize some previous recent work on this matter and will present some new, unpublished findings, which can best be interpreted within the WRH framework. All these studies have been carried out on the encysted embryos of Artemia, an excellent model for such work.

5506 Medicine

REFER ALSO TO CITATION(S) 1260, 1348, 1349, 1350

1874 **(BNL—41770) Stereo and regioselectivity in "Activated" tritium reactions.** Ehrenkaufer, R.L.E.; Hembree, W.C.; Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA); Pennsylvania Univ., Philadelphia (USA). Cerebrovascular Research Center; Columbia Univ., New York (USA). Coll. of Physicians and Surgeons). 1988. Contract AC02-76CH00016. 6p. (CONF-880787—2). NTIS, PC A02/MF A01. Order Number DE89001099/JAW.

From 3. international symposium on the synthesis and applications of isotopically labeled compounds; Innsbruck, Austria (17 Jul 1988).

To investigate the stereo and positional selectivity of the microwave discharge activation (MDA) method, the tritium labeling of several amino acids was undertaken. The labeling of L-valine and the diastereomeric pair L-isoleucine and L-alloisoleucine showed less than statistical labeling at the α-amino C-H position mostly with retention of configuration. Labeling predominated at the single β C-H tertiary (methyne) position. The labeling of L-valine and L-proline with and without positive charge on the α-amino group resulted in large increases in specific activity (greater than 10-fold) when positive charge was removed by labeling them as their sodium carboxylate salts. Tritium NMR of L-proline labeled both as its zwitterion and sodium salt showed also large differences in the tritium distribution within the molecule. The distribution preferences in each of the charge states are suggestive of labeling by an electrophilic like tritium species(s). 16 refs., 5 tabs.

1875 **(DOE/ER/60407—3) Biomedical research with cyclotron produced radionuclides: Progress report, February 1, 1988-September 30, 1988.** Laughlin, J.S.; Bading, J.R.; Balis, M.E.; Benua, R.S.; Brennan, M.F.; Gelbard, A.S. (Sloan-Kettering Inst. for Cancer Research, New York (USA). Biophysics Lab.). Sep 1988. Contract FG02-86ER60407. 40p. NTIS, PC A03/MF A01. Order Number DE89002261/JAW.

This report covers the completion of research carried out in the second year of a 3 year grant. During this period the new gamma camera system, which was designed in the Biophysics Laboratory and whose fabrication was funded by the Institute, was completed and bought into operation. It has capability to monitor simultaneously 3 different radionuclide labels, and to do so rapidly. These features are essential to the metabolic studies being carried out collaboratively by Dr. James Bading and Dr. Brennan's surgical research team. Design and fabrication of this instrument was essential regardless of whether there was access to a PET unit or not. Another instrumental development is the replacement of the cyclotron magnet coils, the addition of harmonic tuning coils and other improvements. The metabolic study program with labeled amino acids in man and animals has progressed significantly as is summarized. The list of compounds prepared and labeled with positron-emitting nuclides in our laboratory, some originally prepared here, illustrates another vital and active contribution to metabolic research from this laboratory.

1876 **(DOE/ER/60528—2) Radiolabelled D_2 agonists as prolactinoma imaging agents: Progress report for period February 1, 1988--January 31, 1989.** Otto, C.A. (Michigan Univ., Dearborn (USA)). 15 Oct 1988. Contract FG02-87ER60528. 17p. NTIS, PC A03/MF A01. Order Number DE89001793/JAW.

Targeted studies completed include the evaluation of tritiated N-0437, evaluation of ^{35}S-cysteamine, evaluation of ^{18}F-FDG and initiation of synthetic efforts towards the synthesis of iodinated N-0437 and pergolide analogs. The direction of the project has been changed due to several factors which include the decided lack of favorable experimental results, the excellence of results using muscarinic receptor ligands in pituitary, brain and heart and the contention of the DOE review panel that the original grant proposal was based on flawed assumptions together with their perceived lack of importance to pituitary imaging. In the final year of this grant, three studies will be completed. The first study is the continuation of synthetic efforts to prepare iodinated N-0437 and pergolide analogs for possible use as brain imaging agents. The second study is directed towards completion of biochemical evaluation of various muscarinic receptor analogs for heart, brain and (possible) pituitary imaging. The third study is to probe the use of quaternized D_2 receptor ligands for imaging peripheral dopaminergic receptors (including the pituitary). 14 refs., 1 fig., 7 tabs.

1877 **(ENEA-RT-PAS—87-23) Trace element levels in hair of a population group living in a small coastal town.** Ingrao, G.; Santaroni, G.P. (ENEA, Casaccia (Italy). Centro Ricerche Energia; Istituto Nazionale della Nutrizione, Rome (Italy)). (ENEA, Rome (Italy)). 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704429/JAW.

Mercury and other trace elements were measured in hair samples collected from subjects of a population group having an average annual fish consumption significantly higher than that for the italian population. The determination of the trace elements was carried out by instrumental neutron activation analysis. The results show that the levels of trace elements in the hair of this population group are higher than those reported for italian population. In particular the high values of mercury concentration found samples indicate that some subjects may exceed the mercury PTWI (Provisional Tolerable Weekly Intake).

1878 **(INIS-mf—11321) Imaging characteristics in rotational panoramic radiography. Practical testing and mathematical models using MTF and ROC analysis.** Sanderink, G.C.H. (Rijksuniversiteit Utrecht (Netherlands)). 8 Dec 1987. 213p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88704558/JAW.

Also published as: Dento-Maxillo-Facial Radiology suppl. 9 (1987); contains summary in Dutch.

This study is concerned with imaging quality in rotational panoramic radiography. This imaging technique records an image of a curved layer within the object radiographed. The shape of this layer normally corresponds with the average form of the dental arch. In the centre of the layer a plane can be found which is depicted with a minimum of unsharpness. Unsharpness increases and the horizontal magnification changes as distance increases from that central plane. The image quality of the layer has been analyzed with the use of mathematical models to estimate the performance of the radiographic diagnostic system. Despite the application of these increasingly sophisticated models the question remains: will the results of the calculations based on these models adequately predict the diagnostic effectiveness of this type of imaging system? In this study a comparison is made between the theoretically determined quality of the system and the diagnostic quality using the observer as a measuring instrument. Experiments were carried out to measure the total unsharpness occurring in rotational panoramic radiography. 116 refs.; 114 figs.; 54 tabs.

1879 **(INIS-mf—11322) Renogram in renovascular hypertension.** Geyskes, G.G. (Rijksuniversiteit Utrecht (Netherlands)). 9 Jun 1987. 140p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88704559/JAW.

Contains summary in Dutch and previously published material.

This thesis comprises five reports on studies with renograms, radionuclide investigations of individual renal function in patients suspected of renovascular hypertension. The main question was to determine whether the renogram could trace functional changes in a kidney with a stenosed artery, before and after percutaneous transluminal angioplasty (PTA) treatment. In a given patient these functional changes could provide information on the significance of the artery stenosis as a cause of that patients' hypertension, and to some extent predict the blood pressure response after PTA treatment. An important issue in these studies is the registration of the renal effects created by captopril on the renogram. This drug with its specific inhibition of the conversion of angiotensine I to angiotensine II, amplifies the impairment of the glomerular filtration rate (GFR) in a kidney behind a stenosis. Captopril-induced deterioration of the GFR can be shown by renography, especially when it occurs in only one of two kidneys and for that reason does escape detection by overall renal function studies. 157 refs.; 16 figs.; 12 tabs.

1880 (PNL—6500-Pt.1, pp 77) **List of DOE radioisotope customers with summary of radioisotope shipments, FY 1986.** Lamar, D.A. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

Data were collected and compiled on radioisotopes produced and sold by Department of Energy (DOE) facilities, and on services rendered by DOE facilities. Compiled data were published and distributed in the document list of DOE Radioisotope Customers with Summary of Radioisotope Shipments, FY 1986, PNL-6361, October 1987. The DOE facilities that supplied information for the compilation were Argonne National Laboratory, Brookhaven National Laboratory, Hanford Engineering Development Laboratory, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Pacific Northwest Laboratory, Savannah River Plant, and UNC Nuclear Industries, Inc. (Hanford). The data provided were reported in several different ways: (1) a list of radioisotopes and services provided by each facility; (2) a list of radioisotope customers, the supplying DOE facility, and the radioisotope or service provided to each customer; and (3) a list of the quantity and value of each radioisotope or service sold by each DOE facility. The sales information covered foreign customers, domestic private customers, and domestic DOE customers.

1881 **Precursors to radiopharmaceutical agents for tissue imaging.** Srivastava, P.C.; Knapp, F.F. Jr. (to Dept. of Energy, Washington, DC). US Patent 4,764,598. 16 Aug 1988. Filed date 13 Mar 1987. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A compound is described comprising: a heterocyclic moiety wherein the hetero member of the heterocyclic moiety is nitrogen; the heterocyclic moiety being quaternary and capable of being reduced to a dihydrogenated form; the heterocyclic moiety having a carbonyl group attached to a carbon of the ring of the heterocyclic moiety; the heterocyclic moiety being coupled at the carbonyl carbon with the amino nitrogen of an aromatic or aromatic alkyl amine; the aromatic or aromatic alkyl amine having attached to a carbon of the aromatic ring a moiety that is readily replaced by a radiohalide selected from the group a substituted triazene, mercuric acetate and a boron moiety.

1882 **Rotor for processing liquids using movable capillary tubes.** Johnson, W.F.; Burtis, C.A.; Walker, W.A. US Patent Application 6-074,739. 17 Jul 1987. 27p. Contract AC05-84OR21400. NTIS, PC A03/MF A01.

A rotor assembly for processing liquids, especially whole blood samples, is disclosed. The assembly includes apparatus for separating non-liquid components of whole blood samples from liquid components, apparatus for diluting the separated liquid component with a diluent and apparatus for transferring the diluted sample to an external apparatus for analysis. The rotor assembly employs several movable capillary tubes to handle the sample and diluents. A method for using the rotor assembly to process liquids is also described. 5 figs.

1883 **Two-dimensional proton J-resolved NMR spectroscopy of neomycin B.** Botto, R.E.; Coxon, B. (Argonne National Lab., IL (USA)). *Journal of Carbohydrate Chemistry;* 3: No. 4, 545-563(1984).

The ^1H NMR spectrum of a solution of neomycin B free base (Structure 1) in D_2O has been assigned completely by two-dimensional, homonuclear J-resolved NMR spectroscopy and spin decoupling at 400 MHz. Proton chemical shifts and proton-proton couplings are reported for all glycoside residues in neomycin B along with their computer simulated spectra. The $^4C_1$ chair conformation has been assigned to the 2,6-diamino-2,6-dideoxy-β-L-idopyranosyl (ring D) portion of the antibiotic (1b) by analysis of the proton coupling constants and chemical shifts. The β-furanose form of the ribosyl portion (ring C) has been assigned. Vicinal proton couplings for the 2-deoxystreptaminyl group (ring B) are consistent with a chair conformation in which all ring substituents are equatorial, and proton chemical shift assignments are based on protonation studies. A computer simulated composite of the individual calculated spectra is presented for comparison with the experimental spectrum of neomycin B. 30 references, 5 figures, 3 tables.

5507 Microbiology

REFER ALSO TO CITATION(S) 1, 15, 356, 357, 360, 1868

1884 **Apparatus and method for detection and characterization of particles using light scattered therefrom.** Johnston, R.G. US Patent Application 6-028,987. 23 Mar 1987. 38p. Contract W-7405-ENG-36. NTIS, PC A03/MF A01.

Apparatus and method for detection and characterization of particles using light scattered therefrom. Differential phase measurements on scattered light from particles are possible using the two-frequency Zeeman effect laser which emits two frequencies of radiation 250 kHz apart. Excellent discrimination and reproducibility for various pure pollen and bacterial samples in suspension have been observed with a single polarization element. Additionally, a 250 kHz beat frequency was recorded from an individual particle traversing the focused output from the laser in a flow cytometer. 13 figs.

5509 Pathology

REFER ALSO TO CITATION(S) 1675, 1681, 1719, 1800, 1847, 1848, 1852, 1975, 1980

1885 **(AD-A—195733/1/XAB) Effect of anticholinesterase agents on airway epithelial function. Annual report, 15 July 1985-14 July 1986.** Marin, M.G. (Rochester Univ., NY (USA)). 1 Aug 1986. 14p. NTIS, PC A03/MF A01.

Irreversible anticholinesterase compounds have potential serious deleterious health effects when employed as chemical warfare agents. Intoxication with these agents will cause an accumulation of acetylcholine at nerve muscle and nerve gland junctions. Because tracheal submucosal glands have rich cholinergic innervation, we hypothesized that exposure to anticholinesterase agents, such as soman, would stimulate glandular secretion. This would cause pathological changes in the important lung defense mechanism of mucociliary clearance. Despite the potential importance of anticholinesterases to lung function, little information was available concerning the effects of these agents on mucociliary transport. The initial technical objectives of this proposal were to modify a technique and to utilize it to study mucociliary transport in the ferret in vivo. Utilizing this technique, we have begun to define baseline mucociliary transport rates in anesthetized ferrets. Furthermore, studies have been under way to determine the effect of atropine on this transport rate. This report delineates the progress thus far. It was shown that mucociliary transport remains relatively constant over a 5 1/2-hour time period, with a mean transport rate between 16.7 and 20.7 mm/min. Initial studies utilizing atropine indicate that there is a decrease in transport rate following the administration of atropine, which reaches a nadir at about 2 hours following administration of atropine.

1886 **(AD-A—195783/6/XAB) Immunological techniques for detection of fungal and dinoflagellate toxins. Annual report, 1 May 1986-30 April 1987.** Chu, F.S. (Wisconsin Univ., Madison (USA)). 14 May 1988. 17p. NTIS, PC A03/MF A01.

Progress in the first year of the present contract is summarized as follows: 1) Antibody against group A trichothecenes was produced after immunization of rabbits with an immunogen prepared by conjugation of T-2 toxin to bovine serum albumin (BSA) at the C-8 position. 2) A monoclonal antibody against T-2 toxin was produced by fusion of P3-NS1/1-Ag4-1 myeloma cells with spleen cells of a BALB/c mouse which had been immunized with 3-Ac-NEOS-HS-BSA. A radioimmunoassay (RIA), using tritiated T-2 toxin and diacetoxyscirpenol (DAS) as marker ligands, was used in screening the hybrid cells. (3) Stability of a cell line capable for the production of monoclonal antibody for the group A trichothecenes was investigated. 4) Efforts to improve the ELISA for diacetoxyscirpenol (DAS) and deoxynivalenol (DON) were made. 5) A new immunoassay involving the use of anti-saxitoxin antibody, biotin-saxitoxin conjugate and avidin-peroxidase complex was developed for saxitoxin. The detection limits of different immunoassays developed in the first year were in the range of 2.5 to 25 pg per assay.

1887 **(PB—88-235510/XAB) Protocols for short-term toxicity screening of hazardous-waste sites.** Greene, J.C.; Bartels, C.L.; Warren-Hicks, W.J.; Parkhurst, B.R.; Linder, G.L. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Jul 1988. 118p. (EPA—600/3-88/029). NTIS, PC A06/MF A01.

This manual contains short-term methods for measuring the toxicity of chemical contaminants in soil, sediment, surface water, and groundwater samples. The algal assay is a chronic test, while all other tests described in the manual are acute tests. The methods are one of several tools, including chemical analysis and field study, used to determine toxicity of hazardous-waste sites. The toxicity tests provided in the manual can be used to detect toxic materials, rank sites based on relative short-term toxicity, and provide a cost-effective approach to monitoring the effectiveness of site cleanup. The toxicity tests in the manual are not required by regulation. However, because toxicity tests measure the integrated effects of complex chemical waste mixtures, they provide a reasonable basis for assessing the toxicity of waste products independent of existing concentration criteria.

1888 **(PB—88-244801/XAB) Dioxin Toxic Equivalency Methodology Subcommittee following its evaluation of EPA's (Environmental Protection Agency's) toxic-equivalency-factor methodology for CDDS (chlorinated dibenzo-p-dioxins) and CDFS (chlorinated dibenzofurans). Report of the science advisory board. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 4 Nov 1986. 12p. (SAB/EC—87/008). NTIS, PC A03/MF A01.

The Assistant Administrator for Air requested the Science Advisory Board to review a draft document which sets an approach for assessing the hazards of chlorinated dibenzo-p-dioxin (CDD) and dibenzofuran (CDF) mixtures relative to the toxicity of the 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD) isomer. The Subcommittee concluded that the draft document represented a successful interim attempt to articulate a scientific rationale and procedures for developing risk-management decisions for mixtures that contain CDDs and CDFs related in structure and activity to TCDD.

1889 (UCRL—21008-Vol.9, pp 5.1-5.16) **Health risks from waterborne, water-washed and water-based infectious organisms of military concern.** Olivieri, A.W.; Danielson, R.E.; Badger, P.G. (Univ. of California, Richmond (USA)). Feb 1988. NTIS, PC A10/MF A01. Order Number DE88013814/JAW.

In Evaluation of military field-water quality. Volume 9. Data for assessing health risks in potential theaters of operation for US military forces: [Final report].

Diseases caused by water-related infectious organisms have always been a major concern for planners of military operations. Many water-related diseases can completely disable the soldier for long periods. The infectious organisms responsible for most water-related diseases can be classified into three groups: bacteria, viruses, and parasites. The routes of transmission to humans that these disease agents can taken can be described as (1) waterborne, where the infected water must be consumed; (2) water-washed, where an indirect exposure to contaminated water causes the disease; and (3) water-based, where the infectious agent is carried by a vector other than water that is closely associated with water. The more important water-related diseases are listed, along with the responsible infectious organisms and the routes of transmission. Water-related disease is usually associated with an absence or compromise of good hygiene practice and sanitary conditions. In all cases the organisms must enter water supplies (or a vector closely associated with water) from an infected individual and survive long enough to infect another individual. It follows that two methods of controlling waterborne and water-washed infectious disease are (1) to keep infected individuals and their wastes away from water supplies and (2) to eliminate the infectious organisms from the water by treatment. Controlling water-based disease can be accomplished by eradication of the aquatic vector.

1890 (UCRL—21008-Vol.9, pp 6.1-6.15) **Regions of concern with regard to water-related infectious organisms.** Olivieri, A.W.; Danielson, R.E.; Badger, P.G. (Univ. of California, Richmond (USA)). Feb 1988. NTIS, PC A10/MF A01. Order Number DE88013814/JAW.

In Evaluation of military field-water quality. Volume 9. Data for assessing health risks in potential theaters of operation for US military forces: [Final report].

Data are not available for assessing the precise location globally of all the aquatic infectious organisms of military concern. In fact, most of the infectious organisms can be considered ubiquitous, especially in the Third World. Nevertheless, in this study they describe two indicators useful as warnings that high concentrations of infectious organisms may exist in the field water of a particular region. They also present data that were available for determining specific locations of Schistosoma spp. and Dracunculus medinensis in water of different regions globally.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 1856, 1857, 1859, 1986

1891 **(LA—11428-MS) Particle-macrophage relationships during the clearance of particles from the alveolar macrophage compartment.** Lehnert, B.E.; Toevs, K.E.; Valdez, Y.E.; Sebring, R.J. (Los Alamos National Lab., NM (USA)). Nov 1988. Contract W-7405-ENG-36. 30p. NTIS, PC A03/MF A01. Order Number DE89002262/JAW.

In this study, we quantitatively characterized the distributions of particles among lavageable AM over a 30 day period after the acute intratracheal instillation of {approximately}3 mg of 1.9 μm dia. polystyrene microspheres into the lungs of rats. Information obtained for particles retained in the lavageable AM compartment and particle-AM distribution data were collectively examined using a simple, first order kinetic model for AM removal from the lung. The results of our analyses suggest that a volume load of particles in a macrophage up to at least {approximately}450 μm^3 does not inhibit the mobilization of macrophages from the alveolar compartment. Additionally, the kinetic analyses of the particle-macrophage distributions suggest that macrophages that replenish those AM that are translocated from the lung on a continual basis during alveolar clearance are not and/or do not remain particle-free in the alveoli. This latter observation can be explained by: (1) the influx of particle-bearing macrophages into the alveoli, or (2) the in situ proliferation of particle bearing AM, or (3) the release of particles by AM and the subsequent phagocytosis of the particles by newly arrived cells, or (4) a combination of these possibilities. 32 refs., 7 figs., 1 tab.

1892 **Physical attributes of desiccated seeds.** Leopold, A.C.; Vertucci, C.W. pp 22-34 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

In an attempt to understand the physiological mechanisms of tolerance of seeds to desiccation, researchers have suggested that water is replaced by some polyol. It has been experimentally established that trehalose could serve as such a replacement. In addition to considering possible alternatives to the trehalose protective system, the authors examine the status of water and water binding in relation to the moisture content of seeds. The initial stage of water uptake is described as a wetting process in which there are three levels of water binding, marked by successively lower binding strength because of the decreasing hydrophilicity of binding sites.

1893 **Physiological activities associated with hydration level in seeds.** Vertucci, C.W.; Leopold, A.C. pp 35-49 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

In this study the authors will try to reveal changes in the organization and function of cell components with hydration. They will first discuss some changes in physiological activity with hydration and then present evidence that conformational changes occur which may be contributing to the observed physiological changes. In their experiments, they have studied the changes in physiological activity as a function of hydration level in seeds in an attempt to answer two questions: (1) at what levels of hydration do seeds begin to exercise the physiological activities associated with the imbibed state and (2) what does water do to a dry cell such that metabolic activity can be reinitiated. The physiological activities on which they will focus are the damages incurred during hydration, oxygen uptake and respiration, light-activated electron transport and light energy transfer, and dormancy breaking. From these experiments, they have observed several discrete levels of physiological activity which correspond to the three levels of water binding.

1894 **Alternation of genetically regulated syntheses in seeds by desiccation.** Kermode, A.R.; Bewley, J.D. pp 59-84 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

During development the metabolism of many cells in the seed is geared towards the massive synthesis of reserve materials such as protein, lipid, and carbohydrate; following germination the reverse process is effected. In the vast majority of seeds, a desiccation period is naturally interpolated between development and germination, and it is logical to surmise that this loss of water plays some role in the switch in cellular activities from an exclusively developmental program to an exclusively germination/growth-oriented program. For several reasons, it is not feasible to use the mature dry seed to study the role of desiccation in terminating development and eliciting germination. Hence, several researchers have taken the approach of subjecting the developing seed to premature desiccation. The fundamental questions that can be addressed using this approach are two. If a seed is dried prematurely, upon subsequent rehydration is its metabolism still geared to resume those developmental events which were incomplete at the time of desiccation? Or does the prematurely imposed drying period cause the cessation of developmental events and lead, upon subsequent rehydration, to a metabolic program associated exclusively with germination and growth? An attempt is made to answer these questions.

1895 **Water content in relation to stress in pollen.** Hoekstra, F.A. pp 102-122 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Upon maturation, pollen may be stressed by dehydration, rehydration, and exposure to excessive humidity for extended periods of time. Exposure to high humidities at sites other than the receptive stigma invites inappropriate syntheses, resulting in loss of vitality. The picture that emerges from the present survey of the effects of dehydration and rehydration seems to indicate that in these cases membrane damage is involved. Such damage is also the most likely cause of the loss of pollen vitality during storage. We have only begun to understand that the nature of the variation in developmental processes and longevity among the different pollen species may initially be determined by differences in membrane composition. Relatively little has been done so far in the field of membrane research in relation to pollen viability. Because of its small size, pollen offers substantial advantages over the much larger and more complex seeds. It is hoped that it will be possible to study the in situ state and functioning of membranes in pollen during desiccation and aging by means of such modern techniques as x-ray diffraction and nuclear magnetic resonance.

1896 **Water and the survival of bacterial spores.** Gould, G.W. pp 143-156 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

An overview is presented which provides good evidence that a relatively low core water content is maintained within spores even when they are suspended in pure water and that this contributes in a major way to desiccation resistance and dormancy. Direct measurements of core water content cannot be made, but the best indirect estimations indicate a range from below about 25 to about 40 g per 100 g dry weight. Rapid hydration of the core occurs when germination is triggered and peptidoglycan in the cortex is hydrolyzed. There is good evidence that this peptidoglycan plays a major role in the maintenance of a low core water content; at the molecular level the means by which this occurs is still unknown. The extreme stasis of ions in spores probably contributes additional resistance. Many of these observations are compatible with the core components' being in a metastable glass state, in which mobility of the water and other molecules that are present is so reduced that it essentially prevents metabolism and raises heat resistance via a large increase in viscosity and a consequent kinetic barrier to normal cell reaction and denaturation processes. However, the data that indicate a more mobile, higher core water status must be considered. More direct measurement of water levels in the various spore compartments is urgently needed. Finally, the intrinsic resistance of the cells' proteins and other components represents the basic resistance on which the desiccation protection is built.

1897 **Ecology of dehydration in soil organisms.** Freckman, D.W. pp 157-168 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

In addition to the physiological mechanisms of survival, ecologists have been interested in the morphological or developmental form of survival and the physical and biological triggers that induce the survival response. Time is required for the organism to respond to the stress, and the response must be initiated by appropriate environmental cues which precede the harsh extreme. Organisms faced with severe environmental stress, defined here as any environmental factor producing physiological stress and decreasing the fitness of the organism, must adapt or die. Dehydration is such a stress, and the physiological and biochemical mechanism of response is the subject of this volume. In this study, emphasis will fall on the ecological response of organisms living in arid soil environments. The author begins by discussing the habitat of the organisms and the soil, shall then examine survival mechanisms of selected biota to desiccation, and last shall consider how the interactions of biota with different responses to desiccation affect the functioning of an arid ecosystem.

1898 **Stabilization of membranes in anhydrobiotic organisms.** Crowe, J.H.; Crowe, L.M. pp 188-208 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Despite the importance of anhydrobiotic organisms in everyday life and the importance of understanding the role of water in living systems, we understand surprisingly little of the mechanisms by which some organisms are capable of surviving dehydration. The authors are trying to elucidate some of these mechanisms and wish to describe in this review their progress over the past several years. They believe that studies in this area not only are of interest to the basic scientist but may also lead to improved methods for preserving biological materials. They decided several years ago that, in view of the complexity of desiccation tolerance, rapid progress was not likely to be made towards understanding mechanisms of survival by studying intact organisms or even intact cells. Thus, they have adopted a decidedly reductionistic approach to the problem and have been studying effects of dehydration on subcellular components and molecules, particularly biological membranes, and the ways in which membranes might be stabilized in anhydrobiotic organisms. While they have made considerable progress, they recognize that much of what they have accomplished may be simplistic and that ultimately it will be necessary to reexamine in intact cells and organisms some of the ideas presented.

1899 **Influence of water on the phase properties of membrane lipids: relevance to anhydrobiosis.** Caffrey, M. pp 242-258 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

An attempt is made to describe one approach to studying the consequences for biological systems, cellular membranes in particular, of an imposed water stress. The author begins by explaining the perspective of someone studying lipid phase properties and how this perspective relates to anhydrobiosis. In order to know how membranes in an intact organisms respond to an imposed water stress, for example, they must understand how the individual lipid and other membrane components behave in isolation under such conditions. In this way they can build up a picture of the complex or natural biology of stress. Attention is focused on the lipid component of cellular membranes. To date a considerable amount of data on the phase properties of lipids has been collected. Unfortu-

nately, this information is scattered throughout the literature. The author set out to bring together these data into a single location so that they can clearly establish their present state of knowledge regarding lipid phase behavior. He will report on this ongoing data compilation in two parts, considering, first, the tabulation of transition temperatures and enthalpies for individual lipid species, and second, miscibility properties in the form of temperature-composition phase diagrams. The possibility of establishing a permanent continuously updated lipid phase data compilation program will also be described.

1900 **Dielectric properties of nearly dry biological systems at megahertz frequencies.** Careri, G.; Giansanti, A. pp 273-285 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

In the past few years the authors have measured the dielectric properties of several intact biological systems in their final stages of dehydration. The main difference between their recent work and previous similar studies relates to their ability to assess the status of water in the sample by simultaneously measuring the evaporation rate and to their ability to store their data in a great amount. Still, their technique suffers from the intrinsic limitations of the multilayer capacitor. Using this set of physical data, they have detected some phenomena of biological interest that they believe should be reported in the present proceedings. In this study they give, first, a detailed account of their experimental technique, with a few remarks about its possible use in other potentially similar applications. The next section deals with the experimental findings, divided into two subsections, one concerned with the detection of protonic currents induced by hydration in dry biological systems and the other with new data relating to the onset of dielectric relaxation in intact biological objects as compared with simpler systems. The study concludes with a few remarks on this physical approach to the study of biological systems.

1901 **Hydration, dehydration, and the stresses and strains in membranes.** Wolfe, J.; Dowgert, M.F.; Maier, B.; Steponkus, P.L. pp 286-305 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Desiccation and rehydration inevitably impose large changes in the volume of cells and organelles and thus produce large strains in the membranes bounding those entities. How large are the stresses associated with varying strains in the membrane? Can or do they disrupt the semipermeability of the membrane? To what extent are membrane stresses affected by cytoplasmic solutes which are concentrated during dehydration? To answer these questions one needs to know: (1) the mechanical properties of membranes, both dynamic and static, and (2) the stresses and strains imposed upon them during desiccation and hydration. These two areas are the subject of this study. Direct mechanical experiments on membranes have thus far been confined to plasma membranes in aqueous suspension and to artificial membranes. Electron micrographic studies of organelles, however, indicate similar behavior to that of the unsupported plasma membrane. When considering dehydration, it is important to distinguish between the behavior of a membrane separating two fluid phases, such as that of an organelle or that of a wall-less cell in suspension, and a membrane which is pressed against a locally rigid phase such as a cell wall. To make this distinction clear, they shall briefly describe the hydraulics of the two cases.

1902 **Dehydration problems associated with the preservation of seed and plant germplasm.** Stanwood, P.C. pp 327-340 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

In reality, when one attempts to conserve plant germplasm, only a fraction of this total pool can be expected to be collected. Consequently, the best possible preservation techniques should be used to ensure the continued availability of these collected samples. The greatest risk associated with preservation efforts are that physiological deterioration may occur in storage or that susceptibility to environmental stresses may depress performance when the stored seeds are planted in the field. A preservation scheme that can attenuate, minimize, or overcome these risk factors is a major goal of plant preservation research. The capability of a given plant material to tolerate desiccation is an important factor in preservation, especially at subzero and liquid nitrogen (-196°C) temperatures. Plant materials can be classed as orthodox (i.e. capable of being desiccated without damage, or desiccation tolerant), or as recalcitrant (i.e. damaged by desiccation below about 30% fresh weight basis). Differences in desiccation tolerance can be characteristics of species or genera and are most notable in seed, pollen, and bud tissue. More research is needed to improve the survival of the seed during the dehydration process. A slower extraction of the water from the seed using a stepwise exposure of proline concentrations and use of combinations of cryoprotectants are two possible areas of practical research. Membrane/hydration interactions in orthodox and recalcitrant seeds need to be defined to better their understanding of the fundamental problems associated with dehydration and survival. As knowledge increases in this area, more refined and effective dehydration schemes can be developed, resulting in the possibility of preserving a wider variety of plant materials.

1903 **Detection and measurement of membrane fusion and leakage.** Strauss, G. pp 343-346 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Perturbation of the bilayer structure of cells and organelles resulting from dehydration or freezing generally leads to the aggregation and fusion of adjacent bilayer membranes, accompanied by leakage of solutes across the bilayers. When studying these processes in model systems represented by unilamellar phospholipid vesicles, they must distinguish between (1) clustering of intact vesicles; (2) fusion of small unilamellar vesicles (SUV) and mixing of their entrapped solutes to form larger uni- or oligolamellar vesicles; and (3) loss of entrapped solutes by leakage into the external aqueous phase during the fusion of SUV. Several techniques which are effective for these purposes are discussed. They are: energy transfer, mixing of aqueous vesicle cores, and leakage of solutes.

1904 **Glassy state and survival of anhydrous biological systems.** Burke, M.J. pp 358-363 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

This paper is intended to direct interest to a property of concentrated solutions that may be relevant to anhydrous biology. Glasses are metastable, they are viscous, and they are either supercooled or supersaturated. They have several properties that may be relevant to near anhydrous organisms. Hirsh et al have provided good evidence for the occurrence of aqueous glasses below -28°C in some of the plants most resistant to freezing. Their evidence was based on the absence of ice crystals in freeze-fractured samples and on the direct observation of second-order transitions in the differential scanning calorimeter. They describe the glasses as a novel method of cryoprotection; however, the method is probably quite common among the freezing-resistant plants. For anhydrous organisms, one might begin to look for glass transitions by differential scanning calorimetry at moderately high temperatures (50°C). T/ sub g/ should depend on water content, with lower T/sub g/ as water content increases. One might also look for the large quantities of solute necessary for an aqueous glass.

5520 Public Health

REFER ALSO TO CITATION(S) 13, 14, 35, 36, 37, 400, 401, 402, 451, 580, 702, 1245, 1649, 1650, 1654, 1656, 1657, 1658, 1659, 1660, 1661, 1662, 1663, 1664, 1665, 1667, 1668, 1681, 1685, 1711, 1980

1905 **(PB—88-236955/XAB) Industrial-hygiene survey report, IMC, Sterlington, Louisiana.** Brown, B.; Dobbin, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). 1 Aug 1977. 14p. (IWS—79.10). NTIS, PC A03/MF A01.

A walk-through survey was conducted at IMC, located in Sterlington, Louisiana, to determine the feasibility of using this site for a health-effects study on nitropropane workers. The facility produced anhydrous ammonia, nitric acid, nitroparaffin derivatives, tris(hydroxyl-methyl)-amino methane, ammonium sulfate crystals, hydroxyl ammonium sulfate, nitropropanes, nitromethane, and nitroethane. Tank farms were used for the storage of fuel oil, ammonia, and nitroparaffins. Workers at the facility involved in production, storage, or working at the loading docks had potential exposure to 2-nitropropane at approximately 1 part per million. There was a safety program in place at the facility. Protective equipment provided by the employer included clothing, glasses, shoes, and respirators. The authors conclude that the length of time since these exposures began is not sufficient to conduct a meaningful pregnancy outcome study, cross sectional medical study or a retrospective cohort mortality study. Unexpectedly, some straight-chain aliphatic amines were detected in the nitroparaffin product which warranted further study as some of these can unite with nitrogen-containing compounds to produce carcinogenic nitroso compounds.

1906 **(PB—88-237490/XAB) NIOSH (National Institute for Occupational Safety and Health) report on occupational safety and health for Fiscal Year 1983 under Public Law 91-596.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1984. 57p. NTIS, PC A04/MF A01.

See also PB—83-214239 and PB—88-237516.

Progress made in the area of occupational safety and health during Fiscal Year 1983 is reviewed. The seven regional offices of NIOSH were listed and their major activities identified. The focus of research was aimed at ten major work-related diseases and injuries. For each area, efforts were underway to develop a comprehensive control strategy and to determine the need for establishing or modifying standards.

1907 **(PB—88-237508/XAB) NIOSH (National Institute for Occupational Safety and Health) report on occupational safety and health for Fiscal Year 1984 under Public Law 91-596.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1985. 70p. NTIS, PC A04/MF A01.

See also PB—88-237490.

The purposes behind the organization of NIOSH and its research objectives and responsibilities are briefly described. The function of each of the divisions is detailed. Much of the work at NIOSH was related to the ten major areas of work related diseases and injuries including: occupational lung disease, musculoskeletal injuries, occupational cancers, traumatic injuries, cardiovascular disease, disorders of reproduction, neurotoxic disorders, noise induced hearing loss, dermatologic conditions, and psychological disorders. The program strategy at NIOSH has been divided into several categories consisting of surveillance, health hazard evaluations, method of control, and the dissemination of information including the publication of documents. A list of publications appearing during 1984 as a result of NIOSH activities in the field is included.

1908 **(PB—88-237573/XAB) NIOSH (National Institute for Occupational Safety and Health) manual of analytical methods (1974 edition).** Crable, J.V.; Taylor, D.G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Labs. and Criteria Development). 1974. 315p. (DHEW/PUB/NIOSH—75-121). NTIS, PC A14/MF A01.

Also available from Supt. of Docs. See also PB—83-105452.

Analytical methods are presented for determining about 135 chemicals in the atmosphere, in the workplace, and in biological materials. Specifically, methods were given for determining lead, mercury, antimony, arsenic, and fluoride in urine; lead and mercury in blood; nitrogen dioxide, carbon monoxide, cyanide, acrolein, beryllium, formaldehyde, organic solvents, hydrogen sulfide, arsenic, 2,4-toluenediisocyanate, sulfur dioxide, p,p'-diphenylmethanediisocyanate, vinyl chloride, cadmium, chromium, ozone, lead, parathion, oil mists, aromatic amines, chromic acid mist, fluoride, hydrogen fluoride, and mercury in air; free silica in atmospheric dust; and quartz in coal dust. For each analytical procedure described the principle of the method was presented followed by the range and sensitivity, possible interferences, precision and accuracy, advantages and disadvantages of the method, apparatus used, reagents, procedure, collection and shipping of samples, analysis of samples, calibration and standards, calculations, and citations to additional references of interest.

1909 **(PB—88-237607/XAB) Attempts at strategic thinking in occupational public health: the Lucas Lecture of 1987.** Millar, J.D. (Royal Coll. of Physicians of London (UK)). 6 May 1987. 35p. NTIS, PC A03/MF A01.

This lecture on strategic thinking in occupational public health stressed that attention must be directed toward the prevention of occupational diseases and injuries through an organized community effort. According to the speaker, such an aim encompasses the various disciplines involved in occupational medicine, safety, and nursing to include such avenues as clinical and social medicine and general public-health practice. A summary was offered of the development of public health and occupational health in the United States, as it grew from the level of state and local responsibility to become a concern of the Federal Government. Occupational medicine also grew at the business sector level with surgical services being established for injured workers at the job site and concerns over toxic exposures growing. The passage of the Occupational Safety and Health Act of 1970 is discussed along with a brief review of new Federal agencies formed by the act. New efforts are being directed at hazard identification and risk assessment, and also at controlling the exposures through preventive or protective measures. Additional efforts are currently being made in the educational field.

1910 **(PB—88-237615/XAB) Program plan by program areas, Fiscal Year 1982.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1981. 269p. (DHHS/PUB/NIOSH—82-108). NTIS, PC A12/MF A01.

See also PB—88-237540.

Inhouse and extramural projects anticipated by NIOSH for Fiscal Year 1982 were outlined. Areas receiving the highest priority for 1982 included reproductive effects, surveillance, neurotoxic effects, respirators, control systems, injury and trauma, information dissemination and document development, and stress. Studies were to continue in the areas of lung disorders, cardiovascular disorders, cancer with work-related connections, physical agents, control systems, personal protective equipment, instrumentation and measurement, work-force development and training, and program administration. Financial resources were listed by program goals and by division for the year 1982. Under the goal of identifying occupational safety and health programs, NIOSH was attempting to form an ongoing occupational health hazard/illness/injury coding system and a survey and surveillance capability which would apply to related effects such as cancer, coronary heart disease, and reproductive effects. Attempts were underway to add at least one question about lifetime work history and known exposures to hazardous materials to all appropriate health-data reporting systems.

1911 **(PB—88-240106/XAB) Industrial environment: its evaluation and control.** Amdur, M.O.; Anticaglia, J.R.; Barnes, E.C.; Belding, H.S.; Bird, F.E. (Clayton (George D.) and Associates, Southfield, MI (USA)). 1973. 707p. NTIS, PC A99/MF E04.

Also available from Supt. of Docs.; Color illustrations reproduced in black and white.

This textbook consists of 50 chapters, written by leading specialists, which encompass the entire field of industrial hygiene, from mathematics and biology to the control of industrial waste. It pro-

vides an excellent overview of the many practical problems involved in the recognition, evaluation, and control of occupational health hazards, and will be of special value to persons entering the field of industrial hygiene and tc those who wish to refresh or broaden their knowledge.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 393, 1843, 2499

1912 **(BARC—1411) Progress report for 1978-87 of the Food Technology and Enzyme Engineering Division.** Adhikari, H.R.; Ninjoor, V.; Satyanarayan, V. (eds.) (Bhabha Atomic Research Centre, Bombay (India). Food Technology and Enzyme Engineering Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1988. 121p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88704413/JAW.

The salient features of the research and development (R and D) activities of the Food Technology and Enzyme Engineering Division of the Bhabha Atomic Research Centre, Bombay, during the decade 1978-1987 are summarized. The Division was a part of the erstwhile Biochemistry and Food Technology which was bifurcated in 1985. The main thrust of the Division's R and D work is directed towards the development of appropriate technologies for radiation preservation of agricultural produce in natural form for prolonged periods without any perceptible change in quality attributes. The suitable parameters have been evolved to apply radiation technology for: (1) arresting sprouting losses in turbers and bulbs, (2) controlling infestation of cereals, spices and ready to eat food items, by insects, microbial pests and pathogens and (3) controlling spoilage of sea foods, fruits and vegetables. It is remarkable to note that the data collected during wholesomeness and toxicological studies of various irradiated food products have been used by the Joint Expert Committee on Food Irradiation of WHO/IAEA/FAO to accord unconditional health and safety clearance to irradiation process using upto 10 KGy radiation doses. The products treated with gamma radiation within this limit do not require toxicological evaluation. The technique for poly-valent radio-vaccine infective diseases in farm animals have been standardized and a vaccine to prevent Salmonella infection in poultry is undergoing field trials in farms. The other activities of the Division are in the fields of enzyme technology, photosynthetic process, and toxicity and genotoxicity of food ingredients and additives. Lists of staff-members of the Division and their publications, their participation in various symposia, seminars, conferences etc. are appended. (M.G.B.).

1913 **(ENEA-RT-TIB—87-45) Fish radurization on board of mediterranean fishing boats.** Leonardi, M.; Tata, A.; Andoloro, F. (ENEA, Casaccia (Italy). Centro Ricerche Energia; Istituto Centrale per la Ricerca Scientifica e Tecnologica Applicata alla Pesca, Rome (Italy)). (ENEA, Rome (Italy)). 1988. 29p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704432/JAW.

The paper presents the results of a feasibility-study carrie out by ENEA with the technical support of ICRAP. Owing to its conclusions, the authors can locate some areas of possible application of fish-radurization both for the inner and for the foreign market. The former may offer in particular the opportunity of the on-board radurization, because of its peculiar characteristics. The latter may be particularly receptive in the case of those countries where refrigerating line is lacking and where the distribution of fresh fish-products seems rather difficult.

1914 **(ISH—120) Viscosity measurement - probably a means for detecting radiation treatment of spices?.** Heide, L.; Albrich, S.; Boegl, K.W.; Mohr, E.; Wichmann, G. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene; LEFO-Institut fuer Lebensmittelforschung und Untersuchung, Ahrensburg (Germany, F.R.)). (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene; Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Dec 1987. 74p. (In German). Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene.

The viscosity of 13 different spices and dried vegetables in total was measured. Optimal conditions were first determined for each product, i.e. concentration, pH-value, temperature, particle size and soaking time. For method evaluation, examinations were primarily performed to study the effect of storage, the reproducibility and the influence of the different varieties of the same spice. In supplement, for pepper, the viscosity was measured as a function of radiation dose. In summation, significant changes in the gel forming capability after irradiation could be observed after preliminary experiments in 8 dried spices (ginger, carrots, leek, cloves, pepper, celery, cinnamon and onions). With 3 spices (ginger, pepper and cinnamon) could the results from examining all different varieties of the same spice be substantiated. An additional influence of storage time on viscosity could not be proved during the investigative period of 8 months. Generally seen, there is no possibility of being able to identify an irradiated spice on the basis of viscosity measurements alone, since the difference between the varieties of one and the same spice is considerably great. However, radiation treatment can be reliably excluded with ginger, pepper and cinnamon, if the viscosities are high (10-20 Pa x s).

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 1916

1915 (ACIESP—60-Vol.1, pp 7) **Radioimmobilization of biocomponents.** Higa, O.Z. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1916 (ACIESP—60-Vol.1, pp 5) **Attenuation of toxins by gamma radiation.** Rogero, J.R. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1917 (ACIESP—60-Vol.1, pp 49) **Radiation property of sugar and its application to accidental dosimeter for inhabitants.** Nakajima, T. (National Inst. of Radiological Sciences, Chiba (Japan)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

1918 **(AD-A—195710/9/XAB) Biological evaluation of radioprotective drugs. Annual report, 1 February 1987-31 January 1988.** Murry, D. (Turner, Mason and Associates, Dallas, TX (USA)). 1 Mar 1988. 76p. NTIS, PC A05/MF A01.

The cellular and molecular mechanisms of radioprotection by aminothiols are being investigated through the use of both cultured mammalian (CHO) cells and a whole-animal model, specific-pathogen free mice. For each of these systems, detailed structure-activity relationships are being compiled that relate the effects of the different drugs on various endpoints for the survival of clonogenic cells and on the induction and repair of several types of DNA lesions in these same cells. The data obtained with cultured cells are used as a means of understanding or predicting the effects on tissues. A major finding is that tissue oxygenation appears to play an important role in determining both the extent and mechanism of protection, and that understanding the interrelationships between oxygen, aminothiols and radiation sensitivity will be a crucial step in our ability to utilize such drugs effectively.

1919 **(CONF-8507175—Summ.) Gene structure and mutation: Gamma field symposia, Number 24.** (Institute of Radiation Breeding, Omiya, Ibaraki (Japan)). 1985. 109p. NTIS (US Sales Only), PC A06. Order Number DE89001182/JAW.

From Gene structure and mutation symposium; Omiya, Japan (18 Jul 1985).

This document contains five papers from a symposium on the effects of radiation on plant tissues and plant growth. Topics include repair of genetic material, radiation-induced modifications in seed storage proteins, a study of waxy surface modifications in plants, and an evaluation of radiation-induced changes in genetic fine structure. (TEM)

1920 **(DOE/ER/60448—3) Comparative mutagenesis of human cells in vitro and in vivo: Second progress report for the period 1 July 1987--31 October 1988.** Thilly, W.G. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1988. Contract FG02-86ER60448. 19p. NTIS, PC A03/MF A01. Order Number DE89001795/JAW.

Using both a human B cell line and T cells from human blood samples, we have mapped the size and positions of deletions inactivating the hprt gene on the X chromosome. This work shows that in spontaneous human B cell mutation that deletions comprise 40% of all detectable mutants, that the sizes of deletions are approximately log normally distributed, and that there are no apparent positions particularly susceptible to deletions within the gene studied. We have found conditions using oxidized phage T7 polymerase which yields an apparent error rate of 10/sup {minus}7/ errors/bp replication, but also amplifies with an efficiency of 90–95% per cycle for sequence of 200–400 bp. We have also shown that these conditions faithfully amplify a 2000 bp sequence with less, but satisfactory, efficiency. We have continued this application of DNA amplification and gradient denaturing gel electrophoresis to the study of the point mutations arising in exon 3 of the hprt gene. We have devised a "double clamp" approach which permits us to observe all point mutations within this sequence. Overall, we have moved rapidly toward our technical goal of devising means to observe point mutational spectra directly in human tissue samples and toward our biological goal of using these techniques to discover said spectra and to apply them to the diagnosis of the principle causes of genetic change in humans. 33 refs., 4 figs.

1921 **(DOE/ER/60539—4) Risk assessment and multiple stages in radiation carcinogenesis.** Burns, F.J.; Sawey, M.J.; Hosselet, S.; Garte, S.J. (New York Univ., NY (USA). Inst. of Environmental Medicine). 1988. Contract FG02-87ER60539. 25p. (CONF-8809137—3). NTIS, PC A03/MF A01. Order Number DE89001805/JAW.

From 14. L. H. Gray conference; Oxford, UK (11 Sep 1988).

Epithelial cancers are induced in rat skin by ionizing radiation in a manner that is consistent with the dual action (i.e., 2 alterations) hypothesis of radiation effects on DNA. This hypothesis states that 2 initial alterations are necessary to start a normal cell on the pathway to career. The expected cancer yield, Y(D,t), as a function of dose, D, and time, t, has the form $Y(D,t) = C(aLD + BD^2)t$,/sup n/, where L is the average LET, D is the radiation dose, a, B are constants and n is an integer. In accordance with multistage theory, n was assumed to be 2 on the basis of the best fit to cancer onset data. Values for a and B were estimated from cancer induction experiments in rat skin exposed to monoenergetic electrons (LET = 0.34 keV/μ) or argon ions (LET = 125 keV/μ). The repair halftime for carcinogenic alterations was found in split dose protocols to be 3.5 +- 1.0 hrs for electron radiation and >24 hrs for argon ions. As an approach to identifying cancer-relevant DNA alterations, skin tumor DNA was analyzed for oncogene activation. K-ras and c-myc oncogenes were activated in highly anaplastic rat skin cancers, whereas only one of these oncogenes, usually c-myc, was activated in squamous cell carcinomas and in comparatively benign basal cell carcinomas. 18 refs., 6 figs.

1922 **(DOE/ER/60539—5) The oncogenic action of ionizing radiation on rat skin: Progress report, February 1, 1988-January 31, 1989.** Burns, F.J.; Garte, S.J. (New York Univ., NY (USA). Dept. of Environmental Medicine). 1988. Contract FG02-87ER60539. 39p. NTIS, PC A03/MF A01. Order Number DE89001783/JAW.

Progress is described in 3 general areas corresponding to the specific aims of the proposal, including DNA strand breaks in the epidermis as a function of radiation penetration; oncogene activation in radiation-induced rat skin cancers; and carcinogenesis in rat skin induced by the neon ion beam. Numerous experiments have established that DNA strand breaks per unit dose in the rat epidermis are reduced by about 60% when the radiation penetration is reduced from 1.0 mm to 0.2 mm. The activation of oncogenes in the radiation-induced rat skin cancers followed a pattern. Four highly malignant cancers exhibited activation of K-ras and c-myc oncogenes, while the remaining 8 cancers exhibited only one or the other of these 2 oncogenes. Of 5 squamous carcinomas, 4 showed K-ras activation and 1 showed c-myc activation. Approximately 200 rats were exposed to the neon ion beam at the Bevalac in Berkeley, CA. The carcinogenicity of energetic electrons (2.0 MeV) was determined in conjunction with the neon ion experiment. It is too early to evaluate tumor incidence in the neon ion experiment, but for electrons an unusually large excess of connective tissue tumors, fibromas and sarcomas, have been observed so far. 59 refs., 2 tabs.

1923 (DOE/ER/60631—1, pp 13-26) **Link between physics and biology.** Zaider, M.; Brenner, D.J.; Hall, E.J.; Kliauga, P. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

In the general causative chain: radiation physics-radiation chemistry - radiobiology - cancer treatment, physics, the initiating and therefore cardinal agent, continues to play the role of the poor relation. The main reason for this state of affairs rests with the fact that most models of radiation action - the actual link between physics and biology - make very little or no use of information concerning the radiation field: they are simply convenient vehicles for describing a large body of radiobiological data with analytical expressions containing a minimum number of parameters. In spite of their practical usefulness such models will not be further considered here. It is a reasonable assertion that the main goal of radiation biophysics is to elucidate the mechanisms of radiation action on biological entities.

1924 (DOE/ER/60631—1, pp 27-30) **Neutron doses at Hiroshima.** Brenner, D.J. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

One of the most startling results of the recent reassessment (DS86) of the radiation doses delivered at Hiroshima and Nagasaki was the order-of-magnitude decrease in the estimated neutron doses. However, an impressive body of evidence is now building up to suggest that the reassessed neutron doses at Hiroshima may need further reassessment. These data primarily consist of thermal-neutron activation measurements on cobalt (in steel) and europium (in rocks and roof tiles).

1925 (DOE/ER/60631—1, pp 31-34) **Neutron RBEs at Hiroshima.** Brenner, D.J. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

The recent reassessment (DS86) of radiation doses at Hiroshima and Nagasaki will have a profound influence on radiation protection standards. One important aspect is the almost order of magnitude reduction in estimated neutron doses at Hiroshima: in the previous dosimetry, the generally increased (per dose) hazard at Hiroshima compared to Nagasaki was interpreted as being due to neutrons having a greater per dose effectiveness, and, on this basis, RBEs were estimated. For example, the RBE for all cancers except leukemia could be estimated to be between about 15 and 50 (80% confidence level). However, the corresponding estimate with the new dosimetry is between 0 and 90 (50% confidence level). Thus it appears, prima facie, that no useful RBE data can be derived from the epidemiological data at Hiroshima. An attempt is made in this study to generate RBEs at Hiroshima based on radiobiological considerations, but making as few assumptions as possible.

1926 (DOE/ER/60631—1, pp 42-48) **Saturation in dual radiation action.** Rossi, H.H.; Zaider, M. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

The theory of dual radiation action (TDRA) was developed with the aim of applying microdosimetry to radiobiology. It therefore can deal only with the first phases in a long chain of events that results in patent effects. It is, however, clear that the initial spatial and temporal pattern of energy deposition has a profound influence on the ultimate outcome. As often happens, the early formulation of the theory contained a number of simplifying assumptions. Although most of these were explicitly stated when the first version of the TDRA was published experimental data obtained when the limitations are important were cited as contrary evidence causing considerable confusion. A more advanced version eliminated some of the restrictions but there remain others, one of which relates to certain aspects of saturation which are addressed here.

1927 (DOE/ER/60631—1, pp 49-57) **Indirect effects in dual radiation action.** Zaider, M.; Rossi, H.H. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

The basic aim in this paper is to establish the link between indirect effects of radiation action and the spatial distribution of radicals at the time of energy deposition as well as throughout subsequent diffusion and interaction. The fact that radicals diffuse for a finite distance before damaging a biomolecule has dramatic effects on their subsequent probability to result in lesions. Thus at very low DMSO concentrations, where $p = 0.5$, one expects - all other things being equal - some 75% of the lesions to result from indirect or semidirect lesions. The number calculated here is lower (15%), a direct result of the fact that such lesions involve proximity functions modulated by diffusion. At higher DMSO concentrations this percentage becomes progressively smaller, as expected. It appears thus that for low-LET radiation, the relative amount of indirect damage in single tracks (also termed intratrack or single events) action is very small. By contrast, intertrack (or two-event) contributions will have the ratio between direct and (indirect + semidirect) contributions given by $p^2/(1-p^2)$. The reason for this is that sublesions from different tracks are uniformly distributed throughout the cell nucleus; their probability of interaction should not depend on any previous diffusional processes. For the example given above ($p = 0.5$) they do expect 65% of intertrack (two-hit) lesions to have resulted from indirect or semidirect mechanisms. This contrast between the almost exclusively direct character of intratrack lesions and the dominant role of indirect action in intertrack lesions produced by low-LET radiation is an important conclusion of this study.

1928 (DOE/ER/60631—1, pp 58-61) **Probability of interaction between elementary radiation-induced chromosomal injuries.** Brenner, D.J. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

The Theory of Dual Radiation Action (TDRA) suggests that ionizing radiation produces elementary injuries, termed sublesions, in the sensitive material of a cell; these sublesions may then interact - in some distance-dependent manner - to produce observable damage. Quantitatively, the model predicts the average yield, anti epsilon, of such lesions after deposition of a dose D to be anti epsilon(D) $\sim$ D integral$_0$/sup ∞/ t(x)y(x)dx + D^2.

1929 (DOE/ER/60631—1, pp 84-86) **Improvements in radon-simulation exposures at RARAF.** Randers-Pehrson, G. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

This study focuses on the effectiveness of the dose delivered to sensitive cells resulting from radon daughters, which are deposited on the inside surface of the respiratory system, subsequently decaying by alpha emission.

1930 (DOE/ER/60631—1, pp 91-93) **Effect of temporal distribution of dose on oncogenic transformation.** Miller, R.C.; Brenner, D.J.; Geard, C.R.; Marino, S.A.; Hall, E.J. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

Risk estimates for neutron hazards are of considerable social and economic importance. Effectiveness per unit dose of X or γ rays (low-LET radiations) has been consistently observed to be dependent on the temporal distribution of dose. In a series of comparisons, 0.5 Gy of single or fractionated (five fractions in 8 h), neutrons of 0.23, 0.35, 0.45, 5.9, or 13.7 MeV were delivered to a synchronous C3H 10T1/2 cells. Transformation frequencies per surviving cell are shown. Cells exposed to one energy (5.9 MeV) show a significant enhancement at the 95% level due to fractionated exposures, and at the 85% confidence level the 0.35- and 0.45-MeV fractionated exposures additionally result in significantly greater transformation frequencies. The frequencies of surviving cells per dish between a single or fractionated exposure vary by less than 10%. In three of five pairwise comparisons, fractionated exposures result in statistically greater frequencies of transformants per dish, and are in complete agreement with the results when induction is expressed as transformants per surviving cell. However, after 0.23-MeV neutron irradiation, the single dose resulted in a greater incidence of transformed foci than the fractionated dose.

1931 (DOE/ER/60631—1, pp 94-100) **Effect of gamma rays on gene-transfer efficiency in DNA repair-proficient and deficient cell lines.** Rubin, J.S. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

This report describes the results of studies designed to examine the effect of ^{137}Cs γ rays on the gene transfer process under a number of different conditions. The different conditions employed here tested: (1) whether the recipient cells' ability to repair radiation-induced DNA lesions, and (2) whether different types of transfecting DNA preparations effected the interaction of γ rays with successful gene transfer. The gene transfer system used in these studies involved the transfection of the chimeric plasmid pSV2-GPT into recipient Chinese hamster ovary (CHO) cell lines. This plasmid contains the Escherichia coli (E. coli) ecogpt gene, which codes for the enzyme xanthine-guanine phosphoribosylantransferase, along with Simian virus 40 (SV40) sequences that allow for the expression of this bacterial gene in mammalian cells. Only those CHO cells which stably integrate these exogenous DNA sequences into their genome and express them can survive selection in growth medium containing MAX (mycophenolic acid, adenine and xanthine). The two different types of DNA preparations used involved transfecting the pSV2-GPT plasmid either in the presence or absence of high molecular-weight carrier DNA.

1932 (DOE/ER/60631—1, pp 101-102) **Aberrations per particle per nucleus: the epitome in ultimate low dose.** Geard, C.R. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

Aberrations largely form from the interaction of pairs of entities (breaks/lesions/DSBs), and hence interaction distance can control aberration formation. This is at present puzzling in that (for low-LET radiations) interaction distances for lesion interaction appear to be of the order of a few to a few tens of nanometers in the initial (linear) part of the dose-response curve and micrometers in the latter (quadratic) part of the dose-response curve. Overall, for ionizing radiations the principal determinant of aberration likelihood is the linear energy transfer (LET) of the radiation. When studying radiations of well-characterized LET, knowledge of morphometry of the irradiated cell leads to a direct estimate of aberrations per particle. For radiation protection considerations, one energy deposition event per nucleus is the ultimate low dose, and such an approach bypasses traditional concepts of absorbed dose and relative biological effectiveness. While there are variations in sensitivity to aberration induction through the cell cycle, as LET

per particle increases linearly, aberration frequency increases quadratically.

1933 **(DP-MS—88-183) Controlled environment estimates of HT uptake by vegetation.** Murphy, C.E., Jr. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 11p. (CONF-881190—1). NTIS, PC A03/MF A01. Order Number DE89001429/JAW.

From 3. Japan-US workshop on tritium radiobiology and health physics; Kyoto, Japan (8 Nov 1988).

A controlled environment system was constructed to determine the rate of uptake of tritium from atmospheric tritiated molecular hydrogen (HT). The system provided control of air temperature, air humidity, light intensity, and the concentrations of HT in the air. Exposure of representative crop species for a period of one hour indicates a very low rate of oxidation of HT by the leaves of the plants. Deposition velocities were calculated to average 2 {times} 10/sup {minus}6/ cm/s. Rates of incorporation of tritium into the organic fraction of the plants was a factor of 30 less than the rate of oxidation. These results suggest that the uptake of HT by plants is not a major source of dose to man following accidental HT releases. 22 refs., 5 figs.

1934 **(ENEA-RT-PAS—87-20) Stochastic model for evaluating the Cs 137 body burden in the man.** Monte, L. (ENEA, Casaccia (Italy). Centro Ricerche Energia). (ENEA, Rome (Italy)). 1988. 13p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704428/JAW.

A stochastic model predicting the retention of Cs-137 in humans is described. The model has been used for two groups of adult humans: healthy women carrier of Duchenne dystrophy and healthy men. The results obtained are compared with the results predicted by ICRP 30.

1935 **(JINR-R—19-87-719) Radiosensitivity-let dependence in yeast. Experiments on diploid cells.** Lobachevskij, P.N.; Cherevatenko, A.P.; Mishonova, V.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704662/JAW.

Submitted to the journal Radiobiologiya.

On the basis of the model reported earlier an analysis was made of experimental dependence of radisensitivity D/sub 0//sup -1/ of diploid yeast Saccharomyces cerevisiae upon linear energy transfer L. The diploid-specific repair of radiation induced damages was shown to be effective to the same extent when cells are exposed to irradiations with different L. Indicated type of repair does not influence directly on D/sub 0//sup -1/(L) dependence character. The visible contribution of diploid-specific repair in cell radioresistance decreases with increasing L. This phenomenon is not connected with decreasing of diploid-specific repair efficiency, but is conditioned by factors of physical and geometrical nature. 11 refs.; 7 figs.; 2 tabs.

1936 **(JINR-R—19-87-791) Separation of a lysogenic bacterial culture from the free phage in prophage λ induction study by ionizing rays.** Bonev, M.N.; Kozubek, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704663/JAW.

A method of lysogenic bacterial culture separation from the free phage (FP) by using Dacron nuclear filters has been proposed. This method permits one to reduce the background of FP about two orders of magnitude and furthermore to study prophage λ induction of E.coli cells irradiated by ionizing rays in a large dose range. 6 refs.; 2 figs.

1937 **(JINR-R—19-87-813) Detection of lac-Escherichia Coli mutants using the method of deep-laid cells.** Tokarova, B.; Amirtaev, K.G.; Krasavin, E.A.; Kozubek, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704664/JAW.

The detection of direct lac/sup -/ mutations in bacterial Escherichia coli cells using tetrazolium chloride has been modified. It enables us to detect mutant colonies with cell densities up to 2X10/sup 4/ cells per plate. It has been shown that the mutation rate for cells irradiated both in cell suspension and as a layer does not differ. 7 refs.; 3 figs.

1938 **(JINR-R—19-87-814) Investigation of SOS-response of Escherichia Coli after γ-irradiation by means of chromotest.** Ogievetskaya, M.M.; Kozubek, S.; Krasavin, E.A.; Drashil, V.; Soshka, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Ceskoslovenska Akademie Ved, Brno. Biofysikalni Ustav). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704665/JAW.

The kinetics of SOS-response have been investigated in γ-irradiated E.coli cells by means of SOS-chromotest. The data on enzymatic activities of β-galactosidase and alkaline phosphatase after incubating the tester strain PQ 37 for various time intervals have been obtained for different doses of γ-radiation. The conclusion have been drawn that the induction factor determined according to the method of Quillardet is not always good quantity for the estimation of SOS-response. 3 refs.; 11 figs.

1939 **(N—88-25427) Preliminary estimates of radiation exposures for manned interplanetary missions from anomalously large solar flare events.** Townsend, L.W.; Nealy, J.E.; Wilson, J.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). May 1988. 16p. (NASA-TM—100620; NAS—1.15:100620). NTIS, PC A03/MF A01.

Preliminary estimates of radiation exposures for manned interplanetary missions resulting from anomalously large solar flare events are presented. The calculations use integral particle fluences for the February 1956, November 1960, and August 1972 events as inputs into the Langley Research Center nucleon transport code BRYNTRN. This deterministic code transports primary and secondary nucleons (protons and neutrons) through any number of layers of target material of arbitrary thickness and composition. Contributions from target nucleus fragmentation and recoil are also included. Estimates of 5 cm depth doses and dose equivalents in tissue are presented behind various thicknesses of aluminum, water, and composite aluminum/water shields for each of the three solar flare events.

1940 **(N—88-27142) Studies of HZE particle interactions and transport for space radiation protection purposes.** Townsend, L.W.; Wilson, J.W.; Schimmerling, W.; Wong, M. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1987. 6p. (NASA-TM—101159; NAS—1.15:101159; CONF-8706351—). NTIS, PC A02/MF A01.

From NASA space life sciences symposium; Washington, DC, USA (21 Jun 1987).

The main emphasis is on developing general methods for accurately predicting high-energy heavy ion (HZE) particle interactions and transport for use by researchers in mission planning studies, in evaluating astronaut self-shielding factors, and in spacecraft shield design and optimization studies. The two research tasks are: (1) to develop computationally fast and accurate solutions to the Boltzmann (transport) equation; and (2) to develop accurate HZE interaction models, from fundamental physical considerations, for use as inputs into these transport codes. Accurate solutions to the HZE transport problem have been formulated through a combination of analytical and numerical techniques. In addition, theoretical models for the input interaction parameters are under development: stopping powers, nuclear absorption cross sections, and fragmentation parameters.

1941 (NUREG/CP—0093, pp vp) **Ultrasensitive techniques for measuring uranium in biological specimens.** Apr 1988. NTIS, PC A08/MF A01 - GPO. Order Number TI88010718/JAW. (CONF-851267—; PNL—6511).

From Meeting on ultrasensitive techniques for measurement of uranium in biological samples and the nephrotoxicity of uranium; Washington, DC, USA (3 Dec 1985).

This presentation sponsored by the Nuclear Regulatory Commission summarizes recent advances in ultrasensitive techniques for the measurement of uranium in biological specimens. Topics of discussion included laser-spectrometric techniques for uranium bioassay, correlation of urinary uranium samples with air sampling results in industrial settings, delayed neutron counting, laser-kinetic phosphometry, isotope dilution mass spectrometry, resonance ionization spectroscopy, fission track analysis, laser-induced fluorescence, and cost, sensitivity, and availability of the techniques.

1942 (NUREG/CP—0093, pp vp) **Recent research on the toxicity of uranium in the kidney.** Apr 1988. NTIS, PC A08/MF A01 - GPO. Order Number TI88010718/JAW. (CONF-851267—; PNL—6511).

From Meeting on ultrasensitive techniques for measurement of uranium in biological samples and the nephrotoxicity of uranium; Washington, DC, USA (3 Dec 1985).

This presentation sponsored by the Nuclear Regulatory Commission summarizes recent advances in ultrasensitive techniques for the measurement of uranium in biological specimens. Topics of discussion include physiology of kidneys, the effects of heavy metals on kidneys, animal studies in uranium nephrotoxicity, comparisons of kidney histology in humans, renal effects in uranium mill workers, renal damage from different uranium isotopes, and Canadian studies on uranium toxicity.

1943 (NUREG/CR—4000-Vol.2) **The MESORAD dose assessment model: Computer code.** Ramsdell, J.V.; Athey, G.F.; Bander, T.J.; Scherpelz, R.I. (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 383p. (PNL—5219-Vol.2). NTIS, PC A17/MF A01 - GPO. Order Number TI89001989/JAW.

MESORAD is a dose equivalent model for emergency response applications that is designed to be run on minicomputers. It has been developed by the Pacific Northwest Laboratory for use as part of the Intermediate Dose Assessment System in the US Nuclear Regulatory Commission Operations Center in Washington, DC, and the Emergency Management System in the US Department of Energy Unified Dose Assessment Center in Richland, Washington. This volume describes the MESORAD computer code and contains a listing of the code. The technical basis for MESORAD is described in the first volume of this report (Scherpelz et al. 1986). A third volume of the documentation planned. That volume will contain utility programs and input and output files that can be used to check the implementation of MESORAD. 18 figs., 4 tabs.

1944 (PNL—6500-Pt.1, pp 3) **Iron stores and risk of cancer.** Stevens, R.G. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

A case-control study of 200 stomach cancer and 85 lung cancer cases occurring between 1973 and 1985 in the Japanese atomic bomb survivor population has been undertaken. Serum samples saved since 1970-1972 from cases and an equal number of controls have been tested for ferritin and transferrin to test the hypothesis that high levels of iron stores increase cancer risk. The data are currently being analyzed.

1945 (PNL—6500-Pt.1, pp 5-6) **Interlaboratory toxicology data base.** Watson, C.R. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The goal of this project is to provide investigators with the capability to assess experimentally derived dose-effect data from many laboratories for evaluating potential insults to human health. Initial efforts, reported here, concentrate on the beagle dog life span health-effects studies supported by DOE at five laboratories. Significant steps include standardization of the medical observation glossary, development of an independent off site data tape archive, and preliminary design of a registry to contain common-format dosimetric estimates and histopathologic observations for each major tissue in the more than 5000 dogs under study.

1946 (PNL—6500-Pt.1, pp 9-23) **Inhaled plutonium oxide in dogs.** Park, J.F. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

This project is concerned with long-term experiments to determine the life span dose-effect relationships of inhaled $^{239}PuO_2$ or $^{238}PuO_2$ in beagles. The data will be used to estimate the health effects of inhaled transuranics. Beagle dogs given a single exposure to $^{239}PuO_2$ or $^{238}PuO_2$ aerosols to obtain graded levels of initial lung burdens (ILB) are being observed for life span dose-effect relationships. Mortality due to radiation pneumonitis and lung tumor increased in the four highest dose-level groups exposed to $^{239}PuO_2$ during the 16-year post exposure period. During the 13 years after exposure to $^{238}PuO_2$, mortality due to lung and/or bone tumors increased in the three highest dose-level groups. Chronic lymphopenia, occurring 0.5 to 2 years after exposure, was the earliest observed effect after inhalation of either $^{239}PuO_2$ or $^{238}PuO_2$ in the four highest dose-level groups that had ILB of $\geqq$ 80 nCi. Other plutonium-exposure-related effects include sclerosis of the tracheobronchial lymph nodes, focal radiation pneumonitis, adenomatous hyperplasia of the liver, and dystrophic osteolytic lesions in the skeleton.

1947 (PNL—6500-Pt.1, pp 39-40) **Mechanisms of radon injury.** Cross, F.T. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

In this new project, they conduct molecular, cellular and whole-animal research relevant to understanding the inhalation toxicology of radon and radon-daughter exposures. The work specifically addresses the exposure-rate effect in radon-daughter carcinogenesis; the induction-promotion relationships associated with exposure to radon and cigarette-smoke mixtures; the role of oncogenes in radon-induced cancers; the effects of radon on DNA as well as on DNA repair processes; and the involvement of growth factors and their receptors in radon-induced carcinogenesis. Preliminary experiments showed that oncogenes are activated in radon-induced lung tumors. They have therefore begun further exposures pertinent to the oncogene and growth-factor studies. An in vitro radon cellular-exposure system was designed, and cell exposures were initiated. Initiation-promotion-initiation studies with radon and cigarette-smoke mixtures have also begun; and they are compiling a radon health-effects bibliography.

1948 (PNL—6500-Pt.1, pp 45-47) **Oncogenes in radiation carcinogenesis.** Frazier, M.E. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

Lung tumors and leukemic cells obtained from studies of life span, dose-effect relationships in beagles exposed either to plutonium by inhalation or to external whole-body gamma-irradiation are being used to examine the role of oncogenes in radiation-induced carcinogenesis. They are in the process of determining whether radiation causes distinctive patterns of genetic change in the activated oncogenes that they have detected. These studies are a necessary first step for determining whether oncogene activation is a cause or an effect of radiation-induced cancers.

1949 (PNL—6500-Pt.1, pp 57-61) **Fetal and juvenile radiotoxicity.** Sikov, M.R. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

In this project they have obtained comparative information on the deposition, distribution, retention, and toxicity of several radionuclides in prenatal and juvenile mammals. The primary approach is quantitative, even though the specific values cannot necessarily be directly extrapolated to man. Accordingly, efforts are directed at identifying patterns, determining phenomenologic interactions, and investigating mechanisms. The resulting relationships are being used by standards-setting groups for developing meaningful radiological protection practices for rapidly growing infants or children and for pregnant women. Injection of neonatal, juvenile and

weanling rats with ^{233}U citrate did not affect the growth of neonates, but growth of juveniles relative to controls was equivocally suppressed, and weanlings had significant growth depression. These ^{233}U exposures produced little mortality in any age group and did not affect mortality in rats subsequently injected with $HgCl_2$. Analyses are in progress to identify patterns associated with placental transfer and fetoplacental deposition values for radionuclides and to help them understand their differences and similarities.

1950 **(PNL-SA—14714) Comparison of premortem and postmortem estimates of plutonium deposited in the skeleton and liver of six individuals.** Sula, M.J.; Bihl, D.E.; Carbaugh, E.H.; Kathren, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830;AC06-65RL01837. 5p. (CONF-880404—20). NTIS, PC A02/MF A01. Order Number DE89001475/JAW.

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

Assessment of organ burdens after internal exposures to radionuclides is often necessary to evaluate the health and regulatory implications of the exposure. The assessment of plutonium activity in skeleton and liver is usually estimated from measurements of plutonium excreted via urine. As part of the overall evaluation of internal dose assessment techniques, it is useful to compare the results of organ burden estimates made from evaluation of urinary excretion data with those made at death from tissue samples collected posthumously from the individual. Estimates of plutonium in the skeleton and liver, based on postmortem analysis of tissue samples for six individuals, were obtained from the US Transuranium Registry (USTR). Bioassay data and other radiation exposure information obtained from the individuals' files were used to estimate their skeleton and liver burdens at the times of their deaths, and these estimates were compared to those obtained through tissue analysis. 6 refs., 2 tabs.

1951 **(PNL-SA—15710) Relationship between bronchiolar dose and lung carcinoma induction following inhalation of $^{239}PuO_2$ in rats.** Sanders, C.L.; Lauhala, K.E.; McDonald, K.E. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 13p. (CONF-8809137—2). NTIS, PC A03/MF A01. Order Number DE89001474/JAW.

From 14. L. H. Gray conference; Oxford, UK (11 Sep 1988).

This manuscript describes preliminary observations in a lifespan and serial sacrifice study with 3332 female, Wistar rats exposed to high-fired $^{239}PuO_2$ aerosols. Sufficient numbers of sham-control and low dose (equivalent to maximal permissible occupational lung deposition of 0.6 kBq in standard man) animals are provided to statistically estimate lung cancer risk and define the cellular-microdosimetric relationships leading to lung tumor formation. Whole-body counting for ^{169}Yb tagged $^{239}PuO_2$ aerosol provided a very accurate method for determining Pu ILB in individual rats (Sanders et al., 1986). The experimental design, methodology and early results of the lifespan study have been previously reported (Sanders et al., 1986, 1988a). 7 refs., 3 figs.

1952 **(RFP-ENV—87) Annual environmental monitoring report, January--December 1987.** Daugherty, N.M. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 27 Apr 1987. Contract AC04-76DP03533. 100p. NTIS, PC A05/MF A01. Order Number DE88015524/JAW.

This report documents the environmental surveillance program at the Rocky Flats Plant. Sample analyses are performed by the Health/Environment Analytical Laboratories (H/EL) of the Health, Safety and Environment Department and by the General Laboratory of the Quality Engineering and Control Department. The report includes an evaluation of plant compliance with all appropriate guides, limits, and standards. Potential public radiation dose commitments were calculated from average radionuclide concentrations measured at the plant property boundary and in surrounding communities. The radioactive and non-radioactive effluents from the Rocky Flats Plant meet the appropriate guides and standards and represent no measurable adverse environmental effects from the operation of the plant during calendar year 1987. The estimated potential radiation doses to the public from plant effluents are below Department of Energy and Environmental Protection Agency dose standards and are well below background dose levels experienced in this region from natural and other non-Rocky Flats Plant sources. 35 refs., 17 figs., 46 tabs.

1953 **(SAND—88-2816C) Simple method for isolating a source of tritiated water vapor.** Metcalf, J.H. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-8810185—1). NTIS, PC A03/MF A01. Order Number DE89001448/JAW.

From Rio Grande Chapter of Health Physics Society meeting; Albuquerque, NM, USA (21 Oct 1988).

A source of tritiated water vapor existed in G tunnel at the Nevada Test Site which resulted in internal, whole-body exposure of personnel working in this complex. In an effort to apply the ALARA concept in this situation, it was necessary to identify the source of the tritium. Attempts were made to locate the source by taking air samples on drierite for laboratory analyses, but this technique was not sensitive enough to pinpoint the source. A procedure will be described using the exchange of tritium in water which was effective in identifying the source of the tritium and allowing corrective actions to be taken. 12 figs.

1954 **Characterization of the rec-1 gene of Haemophilus influenzae and behavior of the gene in Escherichia coli.** Setlow, J.K.; Spikes, D.; Griffin, K. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Bacteriology;* **170**: No. 9, 3876-3881(Sep 1988).

The rec-1 gene of Haemophilus influenzae was cloned into a shuttle vector that replicates in Escherichia coli as well as in H. influenzae. The plasmid, called pRec1, complemented the defects of a rec-1 mutant in repair of UV damage, transformation, and ability of prophage to be induced by UV radiation. Although UV resistance and recombination were caused by pRec1 in E. coli recA mutants, UV induction of lambda and UV mutagenesis were not. We suggest that the ability of the H. influenzae Rec-1 protein to cause cleavage of repressors but not the recombinase function differs from that of the E. coli RecA protein.

1955 **Radiation protection guidelines for space missions.** Fry, R.J.; Nachtwey, D.S. (Oak Ridge National Lab., TN (USA)). *Health Physics;* **55**: No. 2, 159-164(Aug 1988).

The current radiation protection guidelines of the National Aeronautics and Space Administration (NASA) were recommended in 1970. The career limit was set at 4.0 Sv (400 rem). Using the same approach as in 1970 but current risk estimates, a considerably lower career limit would obtain today. Also, there is now much more information about the radiation environments that will be experienced in different missions. Furthermore, since 1970 women have joined the ranks of the astronauts. For these and other reasons, it was considered necessary to re-examine the radiation protection guidelines. This task has been undertaken by the National Council on Radiation Protection and Measurements Scientific Committee 75. Within the magnetosphere, the radiation environment varies with altitude and inclination of the orbit. In outer space missions, galactic cosmic rays, with the small but important heavy-ion component, determine the radiation environment. The new recommendations for career dose limits, based on lifetime excess risk of cancer mortality, take into account age at first exposure and sex. The career limits range from 1.0 Sv (100 rem) for a 24-y-old female up to 4.0 Sv (400 rem) for a 55-y-old male, compared with the previous single limit of 4.0 Sv (400 rem). The career limit for the lens of the eye has been reduced from 6.0 Sv (600 rem) to 4.0 Sv (400 rem).

1956 **Personnel protection challenges in defense and waste management programs.** Faust, L.G.; McLaughlin, T.J.; Stroud, C.M. (Pacific Northwest Lab., Richland, WA (USA)). *Health Physics;* **55**: No. 2, 169-173(Aug 1988).

Three areas are targeted as offering major challenges to the health physicists of the future. One area is in the influx of new technologies, such as laser isotope separation (LIS) and its resultant impact on dosimetry. The LIS process, while generally reducing exposures, also has side effects that make it difficult to detect internal Pu contamination with present methods. Specifically, the LIS process will remove the ^{241}Pu and its ^{241}Am decay product, which

is the estimator for Pu, from the ^{239}Pu stream. A second area involves the requirements now being developed for waste management, which also challenges health physicists by insisting upon safe environments for workers who handle waste products while mandating confirmation and cleanup of hazardous wastes. Thus, developing remote inspection techniques will be vital for personnel protection. Finally, military health physicists are faced with the challenges posed to the civilian professionals as well as challenges unique to the military, such as the education of future health physicists to meet the complex military needs.

1957 **Next decade in external dosimetry.** Griffith, R.V. (Lawrence Livermore National Lab., CA (USA)). *Health Physics;* **55**: No. 2, 177-189(Aug 1988).

In recent years, a number of external dosimetry problems have been solved. However, changes in standards and legal concepts relating to the application of dosimetry results will require further enhancements in measurement techniques and philosophy in the next 10 y. The introduction of effective dose equivalent and the legal use of probability of causation will require that much greater attention be given to determination of weighted organ dose from external exposure. An imminent change--an increase in the fast neutron quality factor--will require a new round of technology development in a field that has just received a decade of close scrutiny. For the future, we must take advantage of developments in microelectronics. The use of random access memory (RAM) and metal-on-silicon (MOS) devices as detector elements, particularly for neutron dosimetry, has exciting possibilities that are just beginning to be explored. Advances in microcircuitry are leading, and will continue to lead, in the development of a new generation of small, rugged and smart radiation survey instruments that will make the most of detector data. It has become possible with very compact instruments to obtain energy spectra, linear-energy-transfer (LET) spectra, and quality factors in addition to the usual integrated dosimetric quantities: exposure, absorbed dose, and dose equivalent. These instruments will be reliable and easy to use. The user will be able to select the level of sophistication that is required for any specific application. Moreover, since the processing algorithms can be changed, changes in conversion factors can be accommodated with relative ease. During the next decade, the use of computers will continue to grow in value to the health physicist.

1958 **Quality factors.** Kerr, G.D. (Oak Ridge National Lab., TN (USA)). *Health Physics;* **55**: No. 2, 241-249(Aug 1988).

The quality factor, Q, is a dimensionless modifier used in converting absorbed dose, expressed in gray (or rad), to dose equivalent, expressed in sievert (or rem). The dose equivalent is used in radiation protection to account for the biological effectiveness of different kinds of radiation. The quality factor is related to both linear energy transfer (LET) and relative biological effectiveness (RBE). The RBE obtained from biological experiments depends in a complex way on the observed biological effect, the specific test organism and the experimental conditions. Judgment is involved, therefore, in the choice of Q. Questions regarding the adequacy of current Q values for neutrons were first raised in a 1980 statement by the National Council on Radiation Protection and Measurements (NCRP) and later in a 1985 statement by the International Commission on Radiological Protection (ICRP). In 1980, the NCRP alerted the technical community to the possibility of a future increase between a factor of 3 to 10 in the Q for neutrons, and in 1985, the ICRP suggested an increase by a factor of 2 in Q for fast neutrons. Both these advisory groups are now recommending essentially the same guidance with regard to Q for neutrons: an increase by a factor of 2. The Q for neutrons is based on a large, albeit unfocused, body of experimental data. In spite of the lack of focus, the data supporting a change in the neutron quality factor are substantial. However, the proposed doubling of Q for neutrons is clouded by other issues regarding its application. These issues are discussed, together with the current database for the neutron quality factor. Improvements are needed to provide better guidance with regard to both Q for neutrons and its application in radiation protection.

1959 **Microdosimetric basis for exposure limits.** Brackenbush, L.W.; Braby, L.A. (Pacific Northwest Lab., Richland, WA (USA)). *Health Physics;* **55**: No. 2, 251-255(Aug 1988).

Consideration of the energy deposited by ionizing radiation in microscopic volumes has led to new insights into dosimetric concepts at the levels of interest in radiation protection. Large amounts of energy are deposited by the passage of low linear-energy-transfer (LET)-charged particles through small volumes. If a typical cell nucleus is considered to be about 7 micron, at an exposure rate of 2.5 X 10(-1) C kg-1 h-1 (1 mR hr-1) from a 60Co irradiation, the average cell nucleus receives one energy deposition event every 12.5 d. Biological processes, which modify radiation damage, typically occur in a few minutes to a few hours. Thus, at occupational exposure levels it is probably the irreparable or misrepaired effects of irradiation that determine the biological consequences. One goal of dosimetry is to measure the incident radiation, making it possible to predict biological risk and set meaningful exposure limits. These measurements must relate to the energy depositions that are responsible for radiation effects at low dose rates, yet the dosimetry system must not be excessively complex to allow use by operational health physicists. Furthermore, our description of the irradiation should be directly measurable. The use of quality factors based upon the energy deposition in a 1-micron-diameter volume of tissue as prescribed in International Commission on Radiation Units Report No. 40 (Joint Task Group 1986) satisfies these requirements. Instrumentation based upon measurement of lineal energy has already been successfully used in health-physics applications. Future changes in the quality factor can be accommodated by changing the algorithm in these microprocessor-based instruments.

1960 **Implications of new technologies and shifting priorities on the understanding of genetic injury.** Grahn, D. (Argonne National Lab., IL (USA)). *Health Physics;* **55**: No. 2, 267-268(Aug 1988).

Some areas of radiation genetics still contain gaps of knowledge, as these studies lost priority when the emphasis in experimental mutagenesis shifted toward the effect of chemical mutagens. This shifted emphasis, however, was accompanied by the development of a better understanding of genetic injury at the molecular level. At the opposite end of the spectrum, more attention was paid to estimates of the direct health costs of the genetic burden in humans and the capacity to make prenatal diagnoses, and to consider reasonable clinical and biochemical intervention. Although, as yet, there are no completely reliable direct methods to estimate the radiation-induced mutation rate in humans, we have come to rely upon data from experimental animals to predict event frequency and extrapolate from these data to predict human health consequences. What will the future offer? Certainly, we should develop a better understanding of molecular genetic damage and, possibly, a better extrapolation model for predicting mutation rate, but many aspects of expected health consequences may remain elusive. We still may have to rely upon (1) an inadequate human population genetic baseline, (2) sometimes arguable perceptions of man-mouse extrapolation models, (3) changing perceptions of gene-environment interactions, and (4) changing levels of short-term selection pressure against detrimental mutations.

1961 **Relationship between radiation standards for the general public and limitation of lifetime risk.** Kocher, D.C.; Eckerman, K.F.; Leggett, R.W. (Oak Ridge National Lab., TN (USA)). *Health Physics;* **55**: No. 2, 339-347(Aug 1988).

This paper discusses the relationship between standards for limiting radiation exposures of individuals in the general public and limitation of lifetime risk. Most current radiation standards for the public in the United States specify limits on dose for each year of exposure. Particularly for internal exposures, we show that such standards may correspond poorly with a limit on lifetime risk when the age dependence of radionuclide intakes and dose is taken into account. We then show that standards which specify limits on annual dose averaged over a lifetime, with a subsidiary limit on dose in any year, correspond more closely with a limit on lifetime risk. Finally, we discuss standards for public exposures that are expressed directly as limits on lifetime risk. The development of risk standards would require consideration of age-dependent radiogenic risks and competing risks from all other causes as well as age-dependent dosimetry. We present sample calculations of lifetime risks from acute and chronic intakes that would support such a standard. We suggest that implementation of a standard for lifetime risk would require modification or abandonment of several radiation

protection practices embodied in standards which specify limits on dose.

1962 **Impact of the probability of causation on the radiation protection program.** Meinhold, C.B. (Brookhaven National Lab., Upton, NY (USA)). *Health Physics;* **55**: No. 2, 375-377(Aug 1988).

Although the probability of causation approach is the only scientific basis on which a given cancer can be judged to be causally related to a given exposure, the impact of this concept on the radiation safety program could be counter-productive. As health physicists, the practices and the concepts we employ have been developed to protect the worker. Effective dose equivalent and committed dose equivalent are protective concepts but useless for probability of causation analysis. Perhaps extensive records will be the only way that good radiation protection and probability of causation analysis can coexist.

1963 **Regulatory perceptions of the future: a view from the United States.** Vallario, E.J. (Department of Energy, Washington, DC (USA)). *Health Physics;* **55**: No. 2, 385-389(Aug 1988).

Herbert Parker, in his keynote address at the 1971 Health Physics Society Topical Symposium in Richland, WA, made an interesting comment which questioned whether the increasing number of radiation protection handbooks really contributed to solving the basic problems of radiation safety. He estimated that by the year 1991 there should be at least 1897 radiation protection handbooks. The U.S. regulator, charged with the responsibility of assuring the protection of the worker, the public and the environment, must face this myriad of expert reports and derive from them radiation protection norms for implementation. Like his European counterpart, the regulator derives requirements based on standards and recommendations of national and international scientific authorities, such as the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP). In recent years, the reports from these scientific authorities recommend changes ranging from simple to complex. The fundamental philosophy of the standards has slowly evolved from a consideration of the risk to individual organs to the consideration of the total risk to the whole body. This philosophy now appears to be evolving from one that considers the risk associated with radiation in comparison with other safe industries to one that balances the risk from radiation with other occupational sources of risk. Nonetheless, if the recommendations of scientific authorities were the only driving force behind the U.S. regulations, the life of the regulator would be relatively easy. Recommendations must be balanced with legal-social-political issues and the resources needed to implement the recommendations.

1964 **Probability that a specific cancer and a specified radiation exposure are causally related.** Breitenstein, B.D. (Hanford Environmental Health Foundation, Richland, WA (USA)). *Health Physics;* **55**: No. 2, 397-398(Aug 1988).

It is fundamental that a given cancer case cannot be attributed with absolute certainty to a prior ionizing radiation exposure, whatever the level of exposure. It is possible to estimate the probability of a causal relationship based on data and models that have been inferred from group statistics. Two types of information are needed to make these probability calculations: natural cancer incidence rates and risks of cancer induction from ionizing radiation. Cancer incidence rates for the United States are available in the report of the Surveillance, Epidemiology and End Results (SEER) program of the National Cancer Institute. Estimates of the risk of cancer induction from ionizing radiation have been published by the Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR) of the National Academy of Sciences, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and the International Commission on Radiological Protection (ICRP). Using the parameters discussed above, the probability of causation formulation estimates the probability that a person who develops a particular cancer after a known quantifiable radiation exposure has the cancer as a result of the exposure. In 1985, the National Institutes of Health, responding to a U.S. Congressional mandate, published radioepidemiologic tables using the probability-of-causation method.

1965 **Application of the ICRP recommendations to revised secondary radiation protection standards.** Kennedy, W.E. Jr.; Corley, J.P. (Pacific Northwest Lab., Richland, WA (USA)). *Health Physics;* **55**: No. 2, 427-431(Aug 1988).

In 1977, the International Commission on Radiological Protection (ICRP) issued Publication No. 26 containing its recommendations for major changes in the conceptual basis for radiation protection. The new recommendations consider total risk (to the whole body) instead of controlling (critical-organ) risk. Subsequent publications and explanatory statements most useful for providing clarification of the intent of the new recommendations have not resolved practical problems encountered in attempting to apply them to either occupational or public exposures. Some of the problems that still exist in applying these recommendations for estimating doses to members of the public include the following: allowance for age differences within an exposed population group, definition of 50-y dose versus lifetime (70-y) dose, definition of negligible risk levels for individual and collective doses, and derivation of appropriate concentration guidelines. The United States is in the process of adopting the revised recommendations of the ICRP. In addition to adopting versions of the primary radiation protection standards, both the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy have developed draft secondary standards that are similar to the Derived Air Concentration values given by the ICRP. This paper presents a brief history of the development of these revised secondary standards, discusses their technical bases, provides a comparison of them, and discusses their limitations and potential misapplication.

1966 **Lung tumor response to inhaled Pu and its implications for radiation protection.** Sanders, C.L.; McDonald, K.E.; Mahaffey, J.A. (Pacific Northwest Lab., Richland, WA (USA)). *Health Physics;* **55**: No. 2, 455-462(Aug 1988).

Multistage models of cancer induction have been accepted in chemical and radiation carcinogenesis for many years. Most models assume that both initiating and promoting events are required for greatest expression of tumor incidence. The sequence of events is important in determining the shape of the dose-response curve. A total of 1058 female, SPF, Wistar, sham-exposed rats and 2134 rats given a single inhalation to 169Yb, 239PuO2 are being studied for lung tumor formation in a life-span study. Histopathological analyses have been completed on 1149 rats. Similar dose-response curves are seen for pulmonary fibrosis pulmonary metaplasia and lung tumor formation. Lung tumor incidences were: 0.6% (0 Gy), 0.5% (0.06 Gy), 0% (0.11 Gy), 0% (0.23 Gy), 4.5% (0.46 Gy), 0% (0.84 Gy), 13.8% (1.9 Gy), 18.6% (3.5 Gy), 72.5% (7.4 Gy), and 84.9% (15 Gy). The dose lung-tumor curve was best fit by a quadratic function and was not well fit by a linear function. It is proposed that the low-dose portion of the quadratic curve represents promotion event(s) due to increasing 239PuO2 particle clustering in subpleural regions, leading to a cellular evolution of focally intense inflammation, fibrosis, epithelial metaplasia and carcinoma formation. A defined, practical threshold dose may be useful with respect to setting radiation protection guidelines for lung tumor induction.

1967 **Legacy of life-span dog studies.** Thompson, R.C. (Pacific Northwest Lab., Richland, WA (USA)). *Health Physics;* **55**: No. 2, 483-485(Aug 1988).

Over the past 35 y, the U.S. Department of Energy and its predecessor agencies have sponsored studies using beagle dogs to determine the effects of radiation, administered in various forms, by various routes, at various levels of intensity, and in various patterns of exposure, with observations continuing for the life of the animal. These studies have been conducted at several laboratories; some are completed, others are still in progress. Taken as a whole, these studies constitute an experiment of potentially enormous significance to the more complete understanding of the biological effects of radiation.

1968 **Chromosomal aberrations induced by in vitro irradiation: comparisons between human sperm and lymphocytes.** Brandriff, B.F.; Gordon, L.A.; Ashworth, L.K.; Carrano, A.V. (Lawrence Livermore National Lab., CA (USA)). *Environmental and Molecular Mutagenesis;* **12**: No. 2, 167-177(1988).

Types and frequencies of structural aberrations in human sperm and lymphocyte chromosomes from one donor were compared after in vitro irradiation with 100, 200, and 400 rad in order to determine if cells with dramatically different chromatin configurations are similarly affected and to investigate the feasibility of using lymphocytes as surrogates for germ cells in risk estimation. Sperm chromosomes were analyzed after fusion with eggs from the golden hamster. Total frequencies of induced aberrations were similar in the two cell types. However, the relative frequencies of rejoined lesions (dicentrics), compared with unrejoined lesions (chromosome breaks and acentric fragments), were different. At the three doses tested, a constant ratio of 5 dicentrics in lymphocytes for every dicentric in sperm was induced. Conversely, for every chromosome break or acentric fragment induced in lymphocytes, 1.7 such events were induced in sperm at the three doses tested.

5602 Thermal Effects

1969 **(SNV—3359) Changes in the submarine vegetation in the Biotest Basin, Forsmark, between 1979 and 1984.** Nyquist, B. (National Swedish Environmental Protection Board, Solna). 1987. 21p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755080/JAW.

The aim of the study was to substantiate the situation in 1979 and 1984 by air photographing. Because of high turbidity, registration of deeper regions of the basin was not possible. Bad contrast between ground and underwater vegetation caused by material deposits made it impossible to quantitatively estimate the changes of vegetation propagation as compared to other nuclear reactor sites. Nor was it possible from the air photo material to distinguish between short filiform algae and dense growth of microalgae on the rock. However, it is concluded from the pictures that an increase of vegetation has occurred as well above as below the water surface. The common reed (Phragmites communis) increased both by establishment of new stands and by acreage increase of old plant stands. (G.B.).

1970 **Adaptation of phytoplankton-degrading microbial communities to thermal reactor effluent in a new cooling reservoir.** Schoenberg, S.A.; Benner, R.; Sobecky, P.; Hodson, R.E. (Univ. of Georgia, Athens (USA)). *Applied and Environmental Microbiology;* **54**: No. 6, 1481-1487(Jun 1988).

In water column and sediment inocula from a nuclear reactor cooling reservoir, natural phytoplankton substrate labeled with ^{14}C was used to determine aerobic and anaerobic mineralization rates for a range of temperatures (25, 40, 55, and 70°C) expected during reactor operation. For experiments that were begun during reactor shutdown, aerobic decomposition occurred at temperatures of <55°C. After two months of reactor operation, aerobic rates increased substantially at 55 and 70°C, although maximum rates were observed at temperatures of ≦ 40°C. The temperature range for which maximum anaerobic mineralization (i.e., the sum of CH_4 and CO_2) was observed was 25 to 40°C when the reactor was off, expanding to 25 to 55°C during reactor operation. Increased rates of 55°C, but not 70°C, correlated with an increase in the ratio of cumulative methane to carbon dioxide produced over 21 days. When reduced reactor power lowered the maximum temperature of the reservoir to 42°C, aerobic decomposition at 70°C was negligible, but remained substantial at 55°C. Selection for thermophilic decomposers occurred rapidly in this system in both aerobic and anaerobic communities and did not require prolonged exposure to elevated temperatures.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 62, 63, 1623, 1648, 1666, 1667, 1670, 1694, 1743, 1788, 1793, 1810, 1811, 1812, 1838, 1849, 1866, 1885, 1920, 1941, 1942, 1944

1971 **(AD-A—196753/8/XAB) Behavioral-physiological effects of red phosphorous smoke inhalation on two wildlife species. Task 1. Inhalation equipment development/ambient CO evaluation/aerosol distribution and air-quality study. Final report, March 1985-December 1986.** Sterner, R.T.; Shumake, S.A.; Johns, B.E.; Thompson, R.D. (Fish and Wildlife Service, Denver, CO (USA). Denver Wildlife Research Center). Dec 1987. 78p. NTIS, PC A05/MF A01.

Tests to evaluate the spatial and temporal uniformity of red phosphorous - butyl rubber smoke produced in a commercial 1-CuM inhalation chamber are described. Several modifications to the inhalation exposure system aimed at improving air filtration, relative humidity, and temperature control for the conduct of animal studies are also presented. Smoke generation involved the use of a system for the continuous generation of phosphoric acid aerosols. Assessments of spatial and temporal uniformity of smoke were based upon measurements of aerosol mass concentration (gravimetric analysis), phosphoric acid deposition (titration analysis), aerosol opacity (infrared sensor), and particle size (cascade impactor); assessments of air quality and combustion products within the chamber involved checks for oxygen, carbon dioxide, phosphine, hexane, and carbon monoxide using either gas chromatography or industrial-hygiene-analyzer tubes. Results for aerosol mass, phosphoric acid, and particle size showed that the within-chamber smoke was highly uniform among burns. Although a number of statistically significant effects were obtained, further inspection showed these to be limited to specific sampling locations and within a priori criteria established to define acceptable uniformity.

1972 **(CONF-880520—) Proceedings of the third international workshop on quantitative structure-activity relationships in environmental toxicology.** Turner, J.E.; England, M.W.; Schultz, T.W.; Kwaak, N.J. (eds.). (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). Jun 1988. Contract AC05-84OR21400. 236p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88013180/JAW.

From 3. international workshop on quantitative structure-activity relationships (QSAR) in environmental toxicology; Knoxville, TN, USA (22 May 1988).

The 3rd International Workshop on Quantitative Structure-Activity Relationships (QSAR) in Environmental Toxicology (QSAR-88) was organized to facilitate the exchange of ideas between experts in different areas working in QSAR. Invited participants were selected to provide a mixture of representatives from biology, chemistry, and statistics as well as industry, government, and academia. The theme for QSAR-88 was "Interrelationships of QSAR and Mechanisms of Toxic Actions." The program was divided into four sessions of invited talks on statistics, molecular descriptors, fish QSARs, and non-fish QSARs and a poster session. These Proceedings contain the text of the 16 invited technical papers and descriptions of the 16 contributed poster presentations. In addition, we include a summary of the Workshop prepared by Dr. Kaiser. The use of structure-activity relationships to elucidate trends in toxicology has been documented for more than a century. However, it is only over the past fifteen years that the modern tools, initially developed for experimental drug design, have been brought to bear on the problem of environmental contamination. The very nature of the field has, from the start, required the collaboration of experts from several scientific disciplines.

1973 **(CONF-8809154—1) Risk assessment models for terrestrial effects of pesticides.** Suter, G.W. II. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01. Order Number DE89000644/JAW.

From International workshop on terrestrial field testing of pesticides; Cambridge, MA, USA (12 Sep 1988).

The purpose of this paper is to describe the role that risk models could play in the registration of pesticides, particularly with respect to field testing. It presents a discussion of the utility of risk models in fate assessment, exposure assessment, and effects assessment, and a discussion of the relation of models to field testing. 18 refs.

1974 **(DGMK—400-5) Health aspects of worker exposure to oil mists.** Jungen, H. (Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)). Feb 1988. 46p. (In German). Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.).

Translated from English: Translation of CONCAWE-Report No. 86/69.

The published information reviewed indicates the following conclusions: A single generic exposure limit is not applicable to all types of oil mists. The present ACGIH TLV of 5 mg/m/sup 3/ provides an adequate safety margin for a broad range of oils recognized as non-carcinogenic, i.e. severely refined base oils or white oils and petrolatums of medicinal or food grade quality and products formulated from the above base oils and containing additives which, by virtue of their nature or the small amounts present, are of no toxicological concern. The ACGIH of 5 mg/m/sup 3/ may not be applicable to: products containing lighter oils such as kerosine, products containing additives of toxicological concern and products used as emulsions. For these types of products acceptable exposure limits can be based on review of specific formulations. An exposure limit below 5 mg/m/sup 3/ would be prudent for products containing potentially carcinogenic oils. Some guidance can be gained from the ACGIH TLV-TWA of 0,2 mg/m/sup 3/ for particulate polycyclic aromatic hydrocarbons (as benzene soluble material).

1975 **(PB—88-233945/XAB) Pulmonary function in normal and elastase-treated hamsters exposed to a complex mixture of olefin-ozone-sulfur dioxide reaction products.** Raub, J.A.; Miller, F.J.; Graham, J.A.; Gardner, D.E.; O'Neil, J.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1983. 11p. (EPA—600/J-83/328). NTIS, PC A03/MF A01.

Pub. in Environmental Research, Vol. 31, 302-310(1983).

An elastase-induced emphysema model was utilized to determine if hamsters with preexisting lung disease were more susceptible to lung damage from air-pollutant exposure. Male golden hamsters, divided into two treatment groups, were given a single intratracheal injection of either 6 units of porcine pancreatic elastase (EMP) or buffer (CNT). After a 4-week recovery period, equal numbers of each group were exposed 23 hr/day x 28 day to filtered air (AIR) or to the complex by-products from a dark-phase-reaction mixture of trans-2-butene, ozone, and sulfur dioxide (MIX). Lung-function measurements on the elastase-treated groups showed changes consistent with mild emphysema. There were no significant differences in lung volumes or lung compliance between the AIR- and MIX-exposed animals. However, the nitrogen washout slope decreased and the diffusing capacity for carbon monoxide increased in both the CNT and EMP hamsters exposed to the MIX. The change in diffusing capacity was greater in normal hamsters than in hamsters with emphysema, and it is hypothesized that animals with impaired lung function had a decreased ability to respond to a pulmonary insult from the mix.

1976 **(PB—88-235130/XAB) Statistical model of environmental contaminants using variance spectrum analysis. Final report.** Thomann, R.V. (Manhattan Coll., New York (USA). Dept. of Environmental Engineering and Science). Aug 1987. 195p. NTIS, PC A09/MF A01.

The purpose of the project is to develop techniques for predicting statistical properties of the concentrations of potentially toxic chemicals in aquatic organisms, such as fish. The statistical properties include mean, variance, coefficient of variation, autocorrelation, and variance spectrum functions. The research direction is prompted by the need to relate the variability of the effluent concentration of chemicals to the variability in the water column and then, in turn, to the variability in a target aquatic organism.

1977 **(PB—88-236047/XAB) Summary review of health effects associated with monochloroethane: health issue assessment.** Opresko, D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Jun 1988. 43p. (EPA—600/8-88/080). NTIS, PC A03/MF A01.

Monochloroethane (ethyl chloride) is released into the environment from anthropogenic sources and has been identified in air samples from locations around the U.S. The major route of exposure is inhalation. Histopathological changes in the lungs, liver and kidneys have been observed in animals at concentrations >20,000 ppm. Severe toxic effects were seen at concentrations >40,000 ppm. Humans exposed to high concentrations exhibited CNS, cardiac, and respiratory effects. There is no conclusive information about chronic toxicity of monochloroethane to humans, and it is in EPA's Group D as to carcinogencity. Monochloroethane was found to be non-teratogenic in one animal study.

1978 **(PB—88-238134/XAB) Monochromosomal hybrid-cell assay for evaluating the genotoxicity of environmental chemicals.** Sandhu, S.S.; Gudi, R.D.; Athwal, R.S. (College of Medicine and Dentistry of New Jersey - New Jersey Medical School, Newark (USA)). Aug 1988. 25p. NTIS, PC A03/MF A01.

The development and utilization of a monochromosomal hybrid-cell assay for detecting aneuploidy and chromosomal aberrations are described. The monochromosomal hybrid-cell lines were produced by a two-step process involving transfer of a marker bacterial gene to a human chromosome and then by integration of that human chromosome into a mouse complement of chromosomes through microcell fusion. For chemical-induced aneuploidy, the segregation of a single human chromosome among cause chromosomes is used as a cytogenetic marker. The genetic assay for aneuploidy is based on the ability of cells to grow in a medium that selects for the loss of the human chromosome. The assay for clastogenicity is based on survival of cells after treatment with chemicals in medium that selects for retention of the human chromosome but loss of its segment containing DT locus. The assays greatly simplify the detection of chromosomal aberrations induced by environmental factors at low-dose levels.

1979 **(PB—88-239017/XAB) Respiratory-tract dosimetry of ^{18}O-labeled ozone in rats: implications for a rat-human extrapolation of ozone dose.** Hatch, G.E.; Wiester, M.J.; Overton, J.H.; Aissa, M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Aug 1988. 13p. (EPA—600/D-88/174). NTIS, PC A03/MF A01.

Efforts to obtain a comparison between rats and humans of the dose of inhaled ozone (O_3) delivered to the lungs during O_3 exposure has been impeded because of the lack of data on the nasopharyngeal removal of O_3 in rats. This study sought to address the need through use of a newly developed tracing technique that involved oxygen-18 labeled O_3. Comparison of the result to a published value of about 40% nasopharyngeal removal in the resting human, yields the conclusion that the O_3 concentration in the rat trachea is about 30% higher than in the human trachea under similar exposure conditions.

1980 **(PB—88-243290/XAB) Draft health-assessment document for nickel, 1986. Final report.** (Environmental Protection Agency, Washington, DC (USA). Science Advisory Board). 11 Jul 1986. 35p. (SAB/EHC—86/026). NTIS, PC A03/MF A01.

See also PB—85-248383.

This draft is clearer, more comprehensive, and responsive to its earlier comments. Additional comments were provided which should be incorporated in the final document before its final publication, particularly in the areas of speciation, pharmacokinetics and choice of epidemiology data. The Committee also concluded that the document appropriately characterized the current scientific literature on the carcinogenicity of nickel compounds.

1981 (PNL—6500-Pt.1, pp 49-56) **Molecular events during tumor initiation.** Springer, D.L. Feb 1988. NTIS, PC A07/MF A01. Order Number DE88011885/JAW.

In Pacific Northwest Laboratory annual report for 1987 to the DOE Office of Energy Research: Part 1, Biomedical Sciences.

The purpose of the project is to extend their understanding of the mechanism of tumor initiation by individual chemical carcinogens and to determine the influences of complex organic mixtures (COM) on this mechanism. Previously, they demonstrated that co-incubation of benzo[a]pyrene (BaP) and COM decreased the metabolism and mutagenic activity of BaP. Because of these influences, five mixtures and BaP were co-administered dermally to mice to initiate tumor development. Results from these studies demonstrated that BaP tumor-initiating activity was decreased substantially by four of the five mixtures. When one of the mixtures was fractionated into chemical class fractions, the polycyclic aromatic hydrocarbon (PAH) and nitrogen-containing polycyclic aromatic compounds (NPAC) fractions were the most effective, and the aliphatic and hydroxy-PAH fractions were the least effective as inhibitors of tumor initiation. Binding of ^{3}H-BaP to epidermal DNA under conditions identical to those used for tumor initiation, were decreased by co-administration of all five mixtures. High performance liquid chromatography radioactivity profiles of enzyme hydrolyzed adducted DNA indicated that, in the presence of the mixtures, the predominant adducts were derived from BaP-diol epoxide (BPDE); however, the mixtures decreased the ratios of the anti-BPDE-deoxyguanosine (dGuo) to syn-BPDE-dGuo adducts. Dermal absorption studies using radiolabeled BaP as the marker compound indicated that the residence time for BaP increased and the concentration of BaP metabolites at the site of treatment decreased when BaP was co-administered with the COM.

1982 (PNL—6685) **Inhalation developmental toxicology studies: Teratology study of tetrahydrofuran in mice and rats: Final report.** Mast, T.J.; Evanoff, J.J.; Stoney, K.H.; Westerberg, R.B.; Rommereim, R.L.; Weigel, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 354p. NTIS, PC A16/MF A01. Order Number DE89001383/JAW.

Tetrahydrofuran (THF), a four-carbon cyclic ether, is widely used as an industrial solvent. Although it has been used in large quantities for many years, few long-term toxicology studies, and no reproductive or developmental studies, have been conducted on THF. This study addresses the potential for THF to cause developmental toxicity in rodents by exposing Sprague-Dawley rats and Swiss (CD-1) mice to 0, 600, 1800, or 5000 ppm tetrahydrofuran (THF) vapors, 6 h/day, 7 dy/wk. Each treatment group consisted of 10 virgin females (for comparison), and ~33 positively mated rats or mice. Positively mated mice were exposed on days 6--17 of gestation (dg), and rats on 6--19 dg. The day of plug or sperm detection was designated as O dg. Body weights were obtained throughout the study period, and uterine and fetal body weights were obtained at sacrifice (rats, 20 dg; mice, 18 dg). Implants were enumerated and their status recorded and live fetuses were examined for gross, visceral, skeletal, and soft-tissue craniofacial defects. 27 refs., 6 figs., 23 tabs.

1983 (UBA-FB—85-038/3) **Air pollution effects on wild plants in rural ecosystems. Pt. 3. Sensitivity tests HF and SO/sub 2//HF; field study near an emittent.** Arndt, U.; Maier-Reiter, W. (Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenoekologie; Umweltbundesamt, Berlin (Germany, F.R.); Commission of the European Communities, Brussels (Belgium)). Oct 1985. 143p. (In German). Umweltbundesamt, Berlin (Germany, F.R.).

Results of methodical research concerning air pollution ecology and of fumigation experiments and field studies on the sensitivity of wild plants to HF are reported. The relative sensitivity of 14 grass species to HF and the modifying influence of abiotic and biotic environmental variables were determined, HF-induced alternations of a greenland plant community were shown and the relative sensitivity of 27 herbaceous wild plants to HF were determined in a screening test. The effects of HF and SO/sub 2/ alone and in combination were investigated. As results of the field study quantitative relationships between accumulated fluoride-content and injury were evaluated and applied for the determination of the sensitivity of the species. (orig./KG) With 100 refs., 20 tabs., 29 figs.

1984 **Collaborative effort to model plant response to acidic rain.** Jacobson, J.; Kuja, A.; Shriner, D.; Perrigan, S.; Irving, P.; Lee, J.; Troiano, J.; Cullinan, V. (Boyce Thompson Institute, Ithaca, NY (USA)). *Journal of the Air Pollution Control Association;* **38**: No. 6, 777-783(Jun 1988).

Radish plants were exposed three times per week to simulated acidic rain at pH values of 2.6 to 5.4 over the course of four weeks in trials performed at Argonne, Illinois; Ithaca and Upton, New York; Corvallis, Oregon; Oak Ridge, Tennessee; and Toronto, Canada. Uniform genotype, soil media and planting techniques, treatment procedures, biological measurements, and experimental design were employed. Growth of plants differed among trials as a result of variation in greenhouse environmental conditions according to location and facilities. Larger plants underwent greater absolute but lower relative reductions in biomass after exposure to the higher levels of acidity. A generalized Mitscherlich function was used to model the effects of acidity of simulated rain or dry mass of hypocotyls using data from three laboratories that performed duplicate trials. The remaining data, from three other laboratories that performed only one trial each, were used to test the model. When the laboratory by trial effect was removed, lack of fit to the Mitscherlich function was insignificant. Thus, a single mathematical model satisfactorily characterized the relationship between acidity and mean plant response.

1985 **Leukocytic responses to the intrapleural deposition of particles, particle-cell associations, and the clearance of particles from the pleural space compartment.** Lehnert, B.E.; Dethloff, L.A.; Valdez, Y.E. (Los Alamos National Lab., NM (USA)). *Journal of Toxicology and Environmental Health;* **24**: No. 1, 41-66(1988). Contract W-7405-ENG-36.

Polystyrene microspheres (2.02 μm diameter) were instilled in the pleural space compartment (PSC) of the Fischer 344 rat. On d 1, 6, 14, and 28 following the instillations, the major cell phenotypes retrieved were quantitated to determine how the pleural free cell population was altered by the particles. Quantitative analyses were also performed to determine the numbers of particles lavaged from the pleural space at the above sacrifice times, and then these particle retention data were used to estimate particle translocation rates from the PSC. Deposition of the particles in the PSC brought about an early recruitment of polymorphonuclear leukocytes (PMN) and an enlargement in the size of the pleural mononuclear phagocyte (PMP) population. PMN numbers substantially decreased by d 6, but continued to remain elevated over the course of the study. The early increase in PMP appeared to subside by d 6, but again increased thereafter. Other notable changes were decreases in the size of the pleural eosinophil population at later times after particle deposition, and an approximate 200-fold increase in lymphocytes by d 28. The particles were cleared from the PSC with a biphasic pattern. Most of the particles were translocated from the PSC to the retrosternal, caudal mediastinal tissue.

1986 **Loss of desiccation tolerance during seed germination: a free radical mechanism of injury.** Senaratna, T.; McKersie, B.D. pp 85-101 of Membranes, metabolism, and dry organisms. Leopold, A.C. (ed.). Ithaca, NY; Cornell University Press (1986). (CONF-8510459—).

From Conference on anhydrous biology; Bellagio, Italy (21 Oct 1985).

Seeds of most species remain viable at extremely low water contents for prolonged periods of time. When exposed to moist conditions, with germination, the seed loses its tolerance of desiccation, exhibiting a physiological switch from tolerance to susceptibility. The biochemical factors which impart desiccation tolerance to the mature seed and the events which occur in the germinating seed as this tolerance is lost have only recently been studied. In this review, the available experimental evidence which has led to the development of a model for the mechanism of desiccation injury in seeds is summarized, and a hypothetical mechanism is suggested which might provide desiccation tolerance in seeds.

1987 **Interactions between acidic precipitation and SO_2 or O_3: effects on plant response.** Shriner, D.S. (Oak Ridge National Lab., TN (USA)). *Phytopathology News;* 2: No. 9, 153(Sep 1978). Contract W-7405-ENG-36.

Limited information exists on the growth effects of acid precipitation, and no previous reports discuss interactions between stress caused by acidic precipitation and either SO_2 or O_3. The effects of acidic precipitation interactions with a single exposure to SO_2, multiple exposures to SO_2, and multiple exposures to O_3 were determined by growth and photosynthetic response measurements of Phaseolus vulgaris L. Red Kidney. Simulated acidic rainfall alone (pH 4.0, 2.0 cm/event, 1 event/wk) did not affect the photosynthetic rate of test plants (compared to controls exposed to pH 5.6). The pH 4.0 treatment rain caused no significant reduction in root, shoot, or pod biomass. A four-week rain pre-treatment (pH's 4.0 and 5.6) did not affect the photosynthetic rate of test plants subsequent exposed to a single fumigation with SO_2 (3 ppm peak, 0.5 ppm-3 hr avg). Plants exposed to SO_2 (as above) or O_3 (0.15 ppm-3 hr avg) at intervals between weekly rain events (a total of four exposures to each pollutant over a five-week period) also showed no effect on photosynthetic rate after five weeks of treatment. Treatments with rain of pH 4.0 in combination with multiple O_3 exposures showed a significant reduction in foliage dry weight. These experiments suggest the need to be cognizant of this additional parameter when interpreting field research with gaseous pollutants.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 524, 1260

1988 **(AD-A—195522/8/XAB) Treatment of laser-induced retinal injuries. Annual report, February 1986-January 1987.** Belkin, M.; Naveh, N. (Tel Aviv Univ. (Israel)). 7 Jun 1987. 46p. NTIS, PC A03/MF A01.

This year's study consisted of two parts: 1. Completion of the study on steroid treatment of eyes. 2. Study on neodymium: yttrium aluminum garnet (YAG) laser induce retinal damage and its relationship with prostaglandin E2 (PGE2) and leukotrienes response. 1. The steroid-treatment study investigated the effect of steroid treatment of eyes with a single argon-laser-induced retinal burn on changes in PGE2 production by the retina/choroid, its accumulation in the vitreous as well as vitreal protein levels indicative of blood retinal barrier (BRB) permeability changes. This study also compared the response of a single argon-laser retinal burn with that of the noncoherent light exposure used during laser irradiation. Laser-induced retinal trauma was associated with an accumulation of PGE2 and protein in the vitreous, a phenomenon not occurring in normal eyes, which is most indicative of an inflammatory reaction. Steroid treatment effectively inhibited the laser induced-inflammatory reaction as in the treated group. Normal vitreal PGE2 and protein levels were maintained throughout a two week period following exposure.

1989 **(AD-A—195735/6/XAB) Functional assessment of laser irradiation. Annual report, March 1984-February 1985.** Robbins, D.O. (Ohio Wesleyan Univ., Delaware (USA). Dept. of Psychology). Mar 1988. 44p. NTIS, PC A03/MF A01.

Exposure of the retina to intense spots of coherent light produces immediate changes in the ability of the animal to perform a visual discrimination task. Relatively large shifts in visual acuity occur during laser irradiation and recovery is somewhat rapid following termination of relatively low-energy, long-duration exposures. With more intense energies, recovery is slower and permanent shifts in postexposure spectral sensitivity often accompany these types of exposure conditions.

1990 **(AD-A—196106/9/XAB) Vibration in the PMEL (Precision Measurement Equipment Laboratory) and Fire Station buildings during engine tests in the T-9 Noise Suppressor System, McConnell AFB Kansas. Final report.** Jenkins, J.C. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Jun 1988. 36p. (USAFOEHL—88-080EH0118FVB). NTIS, PC A03/MF A01.

Vibration measurements were collected at the Precision Measurement Equipment Laboratory (PMEL) and Fire Station buildings during operations of the A/F32T-9 Large Turbo Fan Engine, Enclosed Noise Suppressor System (T-9 NSS) at McConnell AFB KS. The highest vibration levels were measured with an F101 engine operating at afterburner power in the T-9 NSS. The measured floor-vibration levels are well below both the limits recommended to prevent adverse health effects and those limits recommended to prevent decrease in proficiency at performing work tasks. The measured floor-vibration levels do not even exceed the threshold of perception of the most-sensitive individuals to whole-body vibration. Measurements did not rule out the possibility of exceeding recommended levels for interference with vibration sensitive calibrations at the PMEL buildings.

1991 **(AD-A—196462/6/XAB) Biological applications and effects of optical masers. Final report (Annual), February 1962-March 1982.** Ham, W.T.; Mueller, H.A.; Williams, R.C.; Geeraets, W.J.; Ruffolo, J.J. (Virginia Commonwealth Univ., Richmond (USA). Dept. of Biomedical Engineering). 19 Feb 1988. 29p. NTIS, PC A03/MF A01.

Research experiments and projects pertaining to the ocular hazards of lasers and other optical sources are reviewed and discussed in some detail. Early studies to determine threshold retinal damage in the rabbit from ruby and neodymium lasers are described and followed by more elaborate experiments with monkeys using the He;Ne laser. A comparison between threshold retinal lesions in human volunteers, monkeys, and rabbits is given. Retinal damage in the rhesus monkey is evaluated in terms of visual acuity. Quantitative data on solar retinitis as determined in the rhesus monkey are provided and the effects of wavelength on light toxicity are evaluated for eight monochromatic laser lines. Experiments performed at Los Alamos to evaluate the ocular effects and hazards of picosecond and nanosecond pulses of radiation from CO_2 and HF lasers are described. A list of published papers describing the above research is included. The HF laser effects on the rabbit cornea were very similar to those caused by exposure to the CO_2 laser. The energy from the CO_2 and HF lasers is completely absorbed in the superficial layers of the cornea, creating a sharp sonic or shock wave which can disrupt the epitheliai cells but does not penetrate to the stroma, at least for levels of exposure used in these studies. If damage does not penetrate to the stroma, the remarkable recuperative powers of the cornea are able to repair the injury.

1992 **(AD-A—196930/2/XAB) Functional assessment of laser irradiation. Annual report, March 1983-February 1984.** Robbins, D.O. (Ohio Wesleyan Univ., Delaware (USA). Dept. of Psychology). Apr 1988. 40p. NTIS, PC A03/MF A01.

Exposure of the retina to intense spots of coherent light produce immediate and often long-term changes in the ability of an animal to perform a visual discrimination task. The size of the initial deficit and the total time for full recovery of visual functioning is related to the energy, position on the retina, and duration of the exposure.

1993 **(PB—88-243878/XAB) Cerebellar histogenesis in rats exposed to 2450-MHz microwave radiation.** Albert, E.N. (Cheung Labs., Inc., Lanham-Seabrook, MD (USA)). Aug 1988. 26p. NTIS, PC A03/MF A01.

Pregnant rats were either exposed or sham exposed from day 13 of gestation until birth to 2450-MHz linearly polarized microwaves at 10 mW/sq cm. A third matching group served as cage control. After birth, the pups were kept with their mothers for 21 days without any treatment, and at age 21 their brains were prepared for histological analysis. There was a statistically significant difference in the cerebellar area among the three exposure groups. The differences was seen only in the females and not in the males. Purkinje cell density was not significantly different ($P>0.05$) among the three exposure groups. However, Purkinje cell density in the females was highest in the microwave exposed rats and lowest in the cage controls. The differences in the cerebellar area among the three groups may not be attributed to microwave exposure but to some unidentifiable factor which differentiated the cage controls from both exposure groups.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 1241, 1813, 1889, 1890

1994 **(CONF-881183—1) Risk assessment: An introduction.** Travis, C.C. (Oak Ridge National Lab , TN (USA)). 1988. Contract AC05-84OR21400. 34p. NTIS, PC A03/MF A01. Order Number DE88016789/JAW.

From International toxicology seminar on environmental toxicology; Bangkok, Thailand (14 Nov 1988).

Growing public awareness of the potential risk to humans from hazardous chemicals in the environment has led to concern over permissible exposure limits. This awareness has generated a demand for a rational means of estimating risk and of limiting exposure where risk is judged to be excessive. An outcome of this awareness has been the emergence of the field of risk assessment. Risk assessment synthesizes available data on exposure and toxicity of chemicals and uses the best scientific judgment to estimate the associated risk to humans. The risk analysis process involves four consecutive steps: Hazard Identification, Risk Assessment, Risk Management, and Risk Communication. The focus of this presentation is on the risk assessment component of this process. 57 refs., 7 figs.

1995 **(CONF-8806245—1) Risk communication: On the road to maturity.** Russell, M. (Oak Ridge National Lab., TN (USA)). Jul 1988. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01. Order Number DE89000647/JAW.

From Workshop on evaluation and effective risk communication; Washington, DC, USA (2 Jun 1988).

This essay suggests that major opportunities for improving public health now resides in changing individual behavior, and that such changes require effective risk communication. Evaluation of efforts has lagged behind practice, however, and indeed many efforts are likely to be ineffective. Evaluation is the key to improving risk communication practice and will lead to it being taken more seriously, supported better, and performed more professionally. At the same time, there are deep value conflicts between the duties of the State and the rights of individuals when persuasions and manipulative techniques are used. The essay suggests an approach on which guidelines for appropriate use of risk communication can be built that lessens these conflicts.

58 GEOSCIENCES

1996 **(Juel-Bibl—20) Geosciences. Selection of books of the Central Library of the Nuclear Research Center Juelich. 1970-1987.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek). Feb 1988. 383p. (In German, English). NTIS (US Sales Only), PC A17/MF A01. Order Number DE88755236/JAW.

This bibliography on geosciences, selection of books of the Central Library of the Nuclear Research Center Juelich, Germany, 1970-1987, contains more than 2200 single reports.

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 119, 120, 243

1997 **(BFR-R—97-1987) Temperature and heat turnover in lakes during the winter.** Svensson, T. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1987. 153p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88755038/JAW.

The objective of this project has been to measure and analyse temperatures and external thermal energy turnover in a number of different types of lakes, particularly during the time when they are covered by ice. This will provide an improved basis for more reliable calculation or estimation of conditions relating to heat abstraction from various types of lakes. The results have contributed to better knowledge, particularly in the following areas: -Greater empirical knowledge of ice-covered lakes. -Theoretical illustration of heat interrchange between the lake water and its surroundings, and in particular of heat losses to the ice cover. -Development of methods of measurement. -A theoretical framework for classification of the winter conditions of lakes and their prospects for heat abstraction. In particular, the results indicate the wide spread in thermal energy content from year to year at the time of ice formation, the importance of radiation through the ice and the importance of internal mixing and flow mechanisms, which affect the rate of cooling of the water to the ice.

1998 **(CONF-881166—1) Uses of probability graphs for the characterization of fractured rock aquifers near Oak Ridge, Tennessee.** Moore, G.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01. Order Number DE88015556/JAW.

From Symposium on advances in ground-water hydrology; Tampa, FL, USA (16 Nov 1988).

Hydrologic parameters in the fractured rock aquifers near Oak Ridge National Laboratory have a large numeric range, little correlation with other parameters, and abrupt changes in spatial relationships. Tools such as contour maps and regression analyses have limited utility in this area and can produce misleading results. The problem apparently results from nearly unique conditions along each of the many aquifer flow paths. In this situation, the best approach to parameter characterization may be a graphical method of statistical analysis. Cumulative probability graphs require a fairly large amount of data but may show sample or population deviations that otherwise would have been obscure. Some deviations represent only an imperfect distribution of sample values, but others show a change in conditions at deeper levels in the aquifers or show some type of control on population characteristics. All tested parameters in the study area plot as lognormal distributions. On each graph, the slope of the fitted population line shows the change in probability per unit change in parameter value. Any classification of data within a population shows differences, which may or may not be statistically significant, in geometric means and shows nearly identical standard deviations. Information obtained by the comparison of anomalous data values for two or more parameters can be a useful supplement to that obtained by other interpretation procedures. 8 refs., 8 figs.

1999 **(CONF-881186—1) Occurrence, frequency, and significance of cavities in fractured-rock aquifers near Oak Ridge National Laboratory, Tennessee.** Moore, G.K. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1988. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01. Order Number DE88016779/JAW.

From 2. conference on environmental problems in karst terranes; Nashville, TN, USA (16 Nov 1988).

Virtually all wells drilled into bedrock intercept a water-bearing fracture, but cavities occur only in areas underlaid by limy rocks. Multiple cavities are common in wells in the Conasauga and Knox Groups but are rare in the Rome Formation and the Chickamauga Group. The geometric mean height (vertical dimension) of the cavities is 0.59 m, the geometric mean depth is 14 m, the average lateral spatial frequency is 0.16, and the average vertical spatial frequency is 0.019. Differences in cavity parameter values are caused partly by geologic factors such as lithology, bed thickness, and spatial fracture frequency. However, hydrologic factors such as percolation rate, recharge amount, aquifer storage capacity, and differences between lateral and vertical permeability may also be important. Tracer tests show that groundwater velocity in some cavities is in the range 20-300 m/d, and relatively rapid flow rates occur near springs. In contrast, wells that intercept cavities have about the same range in hydraulic conductivity as wells in regolith and fractured rock. The hydraulic conductivity data indicate a flow rate of less than 1.0 m/d. This difference cannot be adequately explained, but rapid groundwater movement may be much more common above the water table than below. Rapid groundwater flows below the water table might be rare except near springs in the Knox Group. 10 refs., 3 figs., 4 tabs.

2000 **(DOE/ER/13747—1) Depositional and diagenetic history of the Edgecliff Reefs of New York and Ontario (Middle Devonian Onondaga Formation).** (State Univ. of New York, Plattsburg (USA). Center for Earth and Environmental Sciences). [1988]. Contract FG02-87ER13747. 3p. NTIS, PC A02/MF A01. Order Number DE89001827/JAW.

This report describes field work in which 25 reefs have been visited, with 17 being mapped, 2 being written off due to lack of exposure, and 6 either not found or no longer accessible. This number includes the entire eastern region of New York State, the entire central region (including the Thomas Corners subsurface pinnacle core which is on loan from the State University of New York College at Fredonia College), and 4 reefs from the western region. To complement the work on the Edgecliff reefs a number of stratigraphic section exposures of the Onondaga have been collected, including the Cherry Valley Section and the Springfield Four Corners Section. Also, the basal Onondaga contact has been examined in a number of quarries. Results include confirmation of the hypothesis that rugosan mound growth was controlled by degree of water turbulence (roughly equivalent to water depth); discovery of increased stratigraphic complexity in the western region of the state; and a re-evaluation of the western reefs in terms of their depositional history and mode of growth.

5802 Geophysics

REFER ALSO TO CITATION(S) 120, 1470, 1601, 1603, 1616

2001 **(AD-A—196096/2/XAB) Discrimination potential of crustal resonance phases. Report for 5 March-5 September 1987.** Burdick, L.J.; Helmberger, D.V. (Woodward-Clyde Consultants, Pasadena, CA (USA)). 15 Oct 1987. 101p. (WCCP-R—88-01). NTIS, PC A06/MF A01.

It is unlikely that regional data recorded at a newly installed array of stations could be used immediately to reliably discriminate events because of uncertainties about the local characteristics of wave propagation. However, the stations would immediately begin to record P sub nl data from small local events. This raises the possibility that the earthquake data base could be used to calibrate the array for discrimination purposes. The relationships is studied between long-period P/sub nl/ data and high-frequency regional phases in the western U.S. This report examines the phase P/sub g/. The high-frequency p/sub g/ phase for small, shallow events typically appears as a complex arrival with a duration of several tens of seconds. This is much longer than the possible duration of the effective source time function even with depth phases taken into account. This phenomenon can be explained by synthesizing P/sub g/ using generalized rays which is a practical computational procedure for a simple layer over a half-space crustal model. If model responses are computed by progressively adding in rays with one reverberation in the crust, then two and so on, it is observed that a sequence of high-frequency arrivals develops spanning the typical duration of P/sub g/. Each successive resonance phase is associated with a higher-order reverberation in the crust. If each arrival contributes a typical amount of high-frequency scattered energy, the long duration of P/sub g/ is simple to understand.

2002 **(DOE/CE/15250—T1) The earthquake barrier: A solution for adding ductility to otherwise brittle buildings: Final report.** Caspe, M.S.; Reinhorn, A.M. (Caspe (M.S.) Co., Inc., San Mateo, CA (USA); State Univ. of New York, Buffalo (USA). Dept. of Civil Engineering). [1988]. Contract FG01-86CE15250. 10p. NTIS, PC A03/MF A01. Order Number DE89001566/JAW.

Brittle buildings, built before current building codes required ductility, are the greatest safety hazard in seismically active regions. The Earthquake Barrier system can provide such buildings with both a "force barrier" and an "energy barrier," so that the superstructure is protected against forces that could cause damage in its fundamental mode and is further protected against the input of energy. 4 figs.

2003 **(SAND—88-2285) Optimum sweep functions for resonant seismic sources.** Hardee, H.C. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01. Order Number DE89001465/JAW.

Controlled seismic sources with constant amplitude output are usually in frequency at a linear rate to produce good autocorrelation functions. Controlled seismic sources with embedded resonances in the sweep range show better autocorrelation results when certain nonlinear sweeps are used. A closed form solution is developed in this paper for the autocorrelation function in terms of Fresnel integrals for both linear and nonlinear sweeps. A reduced form of this solution shows that the peak amplitude of the autocorrelation function is directly proportional to the sweep time and that the width of the initial autocorrelation pulse is inversely proportional to the bandwidth of the sweep. Numerical autocorrelation calculations and supporting analytical results for constant amplitude and resonant amplitude sources show that while the usual linear sweep is satisfactory for the constant amplitude source, a power-function sweep between $n=1.5$ and $n=2.0$ is superior for the resonant amplitude source. 13 refs., 4 figs., 1 tab.

2004 **(SKB-TR—87-25) Bolmen tunnel project - evaluation of geophysical site investigation methods.** Stanfors, R. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Dec 1987. 74p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755270/JAW.

The report presents geophysical measurements along and adjacent to the tunnel and an evaluation of the ability of the various methods to permit prediction of rock mass parameters of significance to stability and water bearing ability. The evaluation shows that, using airborne electro-magnetic surveys, it was possible to indicate about 80% of alla the zones of weakness more than 50 m wide in the tunnel. Airborne magnetic surveys located about 90% of all dolerite dykes more than 10 m wide. Ground-level VLF and Slingram methods of electro-magnetic measurement indicated 75% and 85% respectively of all zones of weakness more than 50 m wide. Resistivity methods were successfully used to locate clay filled and water-bearing fracture zones. About 75% of the length of tunnel over which resistivity values below 500 ohm m were measured required shotcrete support and pre-grouting.

2005 **(USGS-OFR—88-380) Velocity logging and seismic velocity of rocks in the Rainier Mesa area, Nevada Test Site, Nevada.** Carroll, R.D.; Magner, J.E. (Geological Survey, Las Vegas, NV (USA)). 1988. Contract AI08-86NV10583. 323p. Unlimited audience, publicly available. United States Geological Survey, Open File Service, Box 25425, Denver Federal Center, Denver, CO 80225. Order Number TI89001653/JAW.

Velocity data obtained in 38 vertical drill holes in the Rainier and Aqueduct Mesa area were evaluated. Twenty-three geophone surveys and 20 acoustic logs were used to define the in-situ velocity of rocks in the region. The vertical velocity profile can be subdivided into the caprock; the unsaturated zone, the base of which is approximately defined by the top of pervasive zeolitization; the saturated zone of zeolitized rocks; and the pre-Tertiary clastic and carbonate rocks. Comparisons of geophone and acoustic log surveys indicate considerable positive drift (higher acoustic log velocity) in several holes, and none of the postulated causes (dispersion, geologic structure, data error, invasion) can be isolated.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 245, 1183

2006 **Fluid percolation through single fractures.** Pyrak-Nolte, L.J.; Cook, N.G.W.; Nolte, D.D. (Dept. of Materials Science and Mineral Engineering, University of California, Berkeley, and Earth Sciences Division, Lawrence Berkeley Laboratory). *Geophysical Research Letters;* **15**: No. 11, 1247-1250(Oct 1988).

Large deviations from "cubic-law" dependence of laminar fluid flow through fractures on the apparent mechanical aperture of

a fracture can be explained by assuming: 1) cubic-law dependence of flow on the actual local aperture at the microscopic level; 2) conservation of rock volume when deforming the fracture; and 3) macroscopic flow properties are dominated by the critical neck (the smallest aperture along the path of highest aperture through the fracture). copyright American Geophysical Union 1988

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 1569, 1586, 1587, 2336, 2472, 2499

2007 (ACIESP—60-Vol.1, pp 103) **Coded mask telescope foi observations of x and gamma ray sources in the southern sky.** Villela, T.; Jayanthi, U.B.; Neri, J.A.C.F.; Souza, C.A.W.; Figueiredo Filho, N. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2008 (ACIESP—60-Vol.1, pp 103) **Measurements of low energy gamma radiation - Balloon experiment foi supernovae 1987A.** 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2009 (ACIESP—60-Vol.1, pp 106) **Intermediate polars observed in Brazil in the last eight years.** Jablonski, F. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2010 (ACIESP—60-Vol.1, pp 104) **Experiment to measure the anisotropy of the cosmic microwave background radiation.** Villela, T.; Lubin, P. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil); California Univ., Santa Barbara (USA)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2011 (AD-A—196226/5/XAB) **Verification of single-event-upset rate-estimation methods with on-orbit observations. Technical report.** Shoga, M.; Adams, P.; Chenette, D.L.; Kioga, R.; Smith, E.C. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 20 Jun 1988. 27p. (TR—0086A(2940-05)-7). NTIS, PC A03/MF A01.

In an experiment aboard three Leasat vehicles at geosynchronous orbit, single-event upsets (SEU) were continuously monitored in a memory consisting of 93L422 RAMs. Using simultaneous measurements of the high-energy galactic cosmic-ray and solar-flare particle environment from the experiments aboard the IMP-8 satellite, together with at Least mass distribution model and ground test measurements of the SEU susceptibility for the 93L422, accurate estimates of the SEU rate are calculated based on several improvements to the standard methods. These results are discussed and compared to the Leasat flight observations.

2012 (FNAL/C—88/116-A) **Phase transitions as the origin of large scale structure in the universe.** Turok, N. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1988. Contract AC02-76CH03000. 57p. (CONF-8802116—1). NTIS, PC A04. Order Number DE89002286/JAW.

From 27. internationale universitatswochen fur kernphysik; Schladming, Austria (22 Feb 1988).

A review of the formation of large scale structure through gravitational growth of primordial perturbations is given. This is followed by a discussion of how symmetry breaking phase transitions in the early universe might have produced the required perturbations, in particular through the formation and evolution of a network of cosmic strings. Finally the statistical mechanics of string networks, for both cosmic and fundamental strings is discussed, leading to some more speculative ideas on the possible role of fundamental strings (superstrings or heterotic strings) in the very early universe. 115 refs., 16 figs.

2013 (INPE—4139) **Low-energy gamma rays from pulser GX 1+4 balloon results.** Jayanthi, U.B.; Jablonski, F.; Braga, J. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Mar 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780134/JAW.

The results from a search of pulsed emissions in low-energy gamma rays from GX 1+4 source is presented. These pulsations, observed at gamma ray energies from an X-ray pulser, in conjunction with the period determined in X-rays, indicate a spin-down in a contrast with the spin-up behavior observed by others before. (G.D.F.).

2014 (ITEP—45(1988)) **On dynamics of electron neutrino inside supernova and bounds on magnetic moment of ν/sub e/.** Voloshin, M.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704587/JAW.

It is shown that if electron neutrino has magnetic moment $\mu \sim 10/\text{sup } -11/\mu/\text{sub B}/$ then a resonant (i.e. complete) neutrino helicity flip is most likely to take place in the layer of supernova with density rho $\sim$ 10/sup -12/ grammsxcm/sup -3/. Therefore contrary to existing claims, such value of μ not only is consistent with neutrino events from the supernova SN1987A but can also explain mechanism for blowing off the supernova envelope. 16 refs.

2015 (LA-UR—88-2689) **Observations and simulations of recurrent novae: U Sco and V394 CrA.** Starrfield, S.; Sonneborn, G.; Sparks, W.M.; Shaviv, G.; Williams, R.E.; Heathcote, S.; Ferland, G.; Gehrz, R.D.; Ney, E.P.; Kenyon, S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 10p. (CONF-8806226—3). NTIS, PC A03/MF A01. Order Number DE88016323/JAW.

From Conference on a decade of UV astronomy with the IUE satellite; Washington, DC, USA (1 Jun 1988).

We present observations and analysis of the August 1987 outburst of the recurrent nova V394 CrA. This nova was extremely fast and its outburst characteristics closely resembled those of the Recurrent Nova U Sco. In addition to the observations, we have performed hydrodynamic simulations of the outbursts of recurrent novae and present a summary of these results as applied to the outbursts of V394 CrA and U Sco. 8 refs., 2 figs., 1 tab.

2016 (LA-UR—88-2690) **Observations of classical novae in outburst.** Starrfield, S.; Stryker, L.L.; Sonneborn, G.; Sparks, W.M.; Ferland, G.; Wagner, R.M.; Williams, R.E.; Gehrz, R.D.; Ney, E.P.; Kenyon, S. (Los Alamos National Lab., NM (USA)). [1988]. Contract W-7405-ENG-36. 15p. (CONF-8806226—4). NTIS, PC A03/MF A01. Order Number DE88016322/JAW.

From Conference on a decade of UV astronomy with the IUE satellite; Washington, DC, USA (1 Jun 1988).

Over the past 10 years the IUE Satellite has obtained ultraviolet data on a number of novae in outbursts and the characteristics of every one of the outbursts have been different. In addition, our group has also obtained optical and infrared data on many of the same novae. In this paper we present the data on three members of the carbon-oxygen class of novae. 6 refs., 5 figs.

2017 (LA-UR—88-2691) Observations and simulations of Nova Vul 1984 No. 2: A nova with ejecta rich in oxygen, neon, and magnesium. Starrfield, S.; Sonneborn, G.; Stryker, L.L.; Sparks, W.M.; Truran, J.W.; Ferland, G.; Wagner, R.M.; Gallagher, J.S.; Wade, R.; Williams, R.E.; Kenyon, S.; Shaviv, G.; Wu, C.C.; Gehrz, R.D.; Ney, E.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 15p. (CONF-8806226—5). NTIS, PC A03/MF A01. Order Number DE88016321/JAW.

From Conference on a decade of UV astronomy with the IUE satellite; Washington, DC, USA (1 Jun 1988).

Nova Vul 1984 {number←sign}2 has been observed with the IUE Satellite from December 1984 through November 1987 and we expect to be able to observe it with the IUE Satellite for at least another two years. These spectra are characterized by strong lines from Mg, Ne, C, Si, O, N, and other elements. Data obtained in the ultraviolet, infrared, and optical show that this nova is ejecting material rich in oxygen, neon, and magnesium. 16 refs., 5 figs., 1 tab.

2018 (LA-UR—88-2692) Optical and ultraviolet observations of Nova Vul 1987. Starrfield, S.; Stryker, L.L.; Sonneborn, G.; Sparks, W.M.; Wagner, R.M.; Ferland, G.; Gallagher, J.S.; Wade, R.; Williams, R.E.; Gehrz, R.D. (Los Alamos National Lab., NM (USA)). [1988]. Contract W-7405-ENG-36. 16p. (CONF-8806226—2). NTIS, PC A03/MF A01. Order Number DE88016320/JAW.

From Conference on a decade of UV astronomy with the IUE satellite; Washington, DC, USA (1 Jun 1988).

We present a brief summary of the outburst for a nova that was discovered in November 1987 and has been followed since that time. Although we were able to observe it with the IUE at maximum, its ultraviolet energy faded rapidly and after the first two weeks we were no longer able to observe it at IUE wavelengths. It was observed to form a thick dust shell and currently is in the nebular stage. 6 figs.

2019 (N—88-24560) Consistent transport coefficients in astrophysics. Fontenla, J.M.; Rovira, M.; Ferrofontan, C. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1986. 75p. (NASA-TM—101154; NAS—1.15:101154). NTIS, PC A04/MF A01.

A consistent theory for dealing with transport phenomena in stellar atmospheres starting with the kinetic equations and introducing three cases (LTE, partial LTE, and non-LTE) was developed. The consistent hydrodynamical equations were presented for partial-LTE, the transport coefficients defined, and a method shown to calculate them. The method is based on the numerical solution of kinetic equations considering Landau, Boltzmann, and Focker-Planck collision terms. Finally a set of results for the transport coefficients derived for a partially ionized hydrogen gas with radiation was shown, considering ionization and recombination as well as elastic collisions. The results obtained imply major changes is some types of theoretical model calculations and can resolve some important current problems concerning energy and mass balance in the solar atmosphere. It is shown that energy balance in the lower solar transition region can be fully explained by means of radiation losses and conductive flux.

2020 (N—88-24561) Generation of flux tube waves in stellar convection zones. 1. Longitudinal tube waves. Musielak, Z.E.; Rosner, R.; Ulmschneider, P. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1987. 34p. (NASA-TM—101152; NAS—1.15:101152). NTIS, PC A03/MF A01.

The source functions and the energy fluxes are derived for wave generation in magnetic flux tubes embedded in an otherwise magnetic- field free, turbulent, and compressible fluid. Specific results for the generation of longitudinal tube waves are presented.

2021 (N—88-24562) Model for the x-ray binary 4U1820-30. Miyaji, S. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1986. 17p. (NASA-TM—101143; NAS—1.15:101143). NTIS, PC A03/MF A01.

Analysis of x-ray bursts from 4U1820-30 implies that the mass and radius of the neutron star are 1.4 solar mass and 8 km, respectively, and that the accreted material is hydrogen rich. On the other hand, the recently discovered orbital period of 685 seconds suggests that the companion is a degenerate star consisting mostly of helium. It is shown that apparent conflict can be resolved if the mass and radius of the companion are 0.08 solar mass and 2 x 10 to the 9th cm, respectively, with a mean hydrogen concentration by weight of less than X greater than = 0.1. The possible origin of such a binary system is discussed.

2022 (N—88-24563) Colliding stellar winds in the eclipsing Wolf-Rayet binary V444 Cygni. Brown, D.N.; Shore, S.N. (Washington Univ., Seattle (USA)). 1988. 21p. (NASA-CR—182937; NAS—1.26:182937). NTIS, PC A03/MF A01.

High resolution spectra of V444 Cygni have been obtained using the International Ultraviolet Explorer Satellite. These spectra span both eclipses and include one observation at third quadrature. Together with seven archival spectra, they provide reasonably complete phase coverage for the system. The variations in the P Cygni profiles of the He(II) and N(IV) lines, imply the existence of a low density region in the WR wind. This region occupies a relatively narrow range of orbital phase coinciding with the highest terminal velocities observed in C IV. These data are interpreted to be evidence of an interaction region separating the winds of the O-star and Wolf-Rayet star.

2023 (N—88-24565) Precipitation of energetic heavy ions into the upper atmosphere of Jupiter. Horanyi, M.; Cravens, T.E.; Waite, J.H. Jr. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Feb 1987. 74p. (NASA-TM—101155; NAS—1.15:101155). NTIS, PC A04/MF A01.

Evidence for auroral particle precipitation at Jupiter was provided by the ultraviolet spectrometers onboard the Voyagers 1 and 2 spacecraft and by the International Ultraviolet Explorer (IUE). Magnetospheric measurements made by instruments onboard the Voyager spacecraft show that energetic sulfur and oxygen ions are precipitating into the upper atmosphere of Jupiter. A theoretical model has been constructed describing the interaction of precipitating oxygen with the Jovian atmosphere. The auroral energy is deposited in the atmosphere by means of ionization, excitation, and dissociation and heating of the atmospheric gas. Energetic ion and electron precipitation are shown to have similar effects on the atmosphere and ionosphere of Jupiter.

2024 (N—88-24566) Jovian aurora: electron or ion precipitation. Waite, J.H. Jr.; Clarke, J.T.; Cravens, T.E. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1986. 31p. (NASA-TM—101153; NAS—1.15:101153). NTIS, PC A03/MF A01.

High signal-to-noise spectra of the Jovian aurora at UV wavelengths obtained using the International Ultraviolet Explorer Observatory (including the brightest Jovian aurora observed to date) set strigent upper limits for sulfur and oxygen emissions, which would be associated with the precipitation of energetic heavy ions in the upper Jovian atmosphere if they were solely responsible for Jovian auroral processes. Model calculations of heavy ion precipitation and corresponding estimates of the associated sulfur and oxygen UV emissions previously carried out suggest emission values for 1304 A OI emission that are at least 30 times larger than the upper limit values set by the IUE observations reported. On the other hand the observed (feature of SII at 1256 A of 2 kR) is quite comparable to the theoretically predicted emission intensity. Taken together these observations and calculations suggest that electron as well as ion precipitation play a role in Jovian auroral processes. In light of earlier X-ray observations and in-situ plasma observations that suggest energetic heavy ion precipitation in the Jovian auroral zone, a scenario is suggested where heavy ion auroral energy deposition is concentrated at altitudes below the homopause. Electrons with energies of 10 to 30 keV are responsible for the bulk of the observable UV and EUV emissions since they

deposit their energy above the methane absorbing layer defined by the homopause.

2025 **(N—88-24569) Gamma-ray spectrometer experiment on the solar maximum mission satellite. Semiannual progress report, 16 April-15 November 1987.** Chupp, E. L. (New Hampshire Univ., Durham (USA)). Jun 1988. 27p. (NASA-CR—182977; NAS—1.26:182977). NTIS, PC A03/MF A01.

The major activities (through 15 November 1987) of the Solar Maximum Mission Gamma-Ray Spectrometer (SMM GRS) team members at the University of New Hampshire and the Naval Research Laboratory and the work of the Guest Investigators since the last Semi-Annual Report are summarized. In addition, an updated list of published papers and invited papers or papers presented at scientific meetings is provided.

2026 **(N—88-24571) Benchmark for galactic cosmic ray transport codes.** Wilson, J.W.; Townsend, L.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1987. 15p. (NASA-TM—101157; NAS—1.15:101157). NTIS, PC A03/MF A01.

A nontrivial analytic benchmark solution for galactic cosmic ray transport is presented for use in transport code validation. Computational accuracy for a previously-developed cosmic ray transport code is established to within one percent by comparison with this exact benchmark. Hence, solution accuracy for the transport problem is mainly limited by inaccuracies in the input spectra, input interaction databases, and the use of a straight ahead/velocity-conserving approximation.

2027 **(N—88-25093) Photochemical and thermal modeling in the early atmosphere of the earth. Final report, 1 October 1981-31 December 1987.** Yung, Y.L. (California Inst. of Tech., Pasadena (USA)). Jul 1988. 3p. (NASA-CR—183029; NAS—1.26:183029). NTIS, PC A02/MF A01.

The simplest carbon compounds, present in the terrestrial and planetary atmospheres, exhibit a wide range of oxidation states, carbon dioxide and methane being the most oxidized and the most reduced form of carbon, respectively. The question arises as to the origin and the interconversion among the carbon species. The chemical pathways for the conversion of CH_4 to CO and CO_2 are for the most part known. The reverse process, the reduction of CO to CH_4 is however, poorly understood. A new reaction is proposed, $H_2CO + H + M$ yields $CH3O + M$, which might play a fundamental role in the reduction of CO or CH_4. An update is presented of nitrile photochemistry on Titan.

2028 **(N—88-25406) Ultraviolet spectra of subluminous objects found in the Kiso Schmidt survey and systematic reanalysis of the archived ultraviolet spectra of white dwarfs observed with the IUE satellite under the Astrophysics Data Program (ADP). Semiannual report.** Wegner, G. A. (Dartmouth Coll., Hanover, NH (USA)). Jun 1988. 8p. (NASA-CR—182976; NAS—1.26:182976). NTIS, PC A02/MF A01.

Recent research under NASA grant NAG5-971 consisted of the performance of two projects in conjunction with the International Ultraviolet Explorer (IUE) satellites. These are: (1) to look at the ultraviolet spectra of subluminous stars identified from visual wavelength spectroscopy that had been originally discovered from the Kiso Schmidt survey for ultraviolet excess stars and (2) to carry out a systematic reanalysis of the archived IUE spectra of white dwarfs. This report presents information on the progress of the rereduction of over 600 IUE white dwarf spectra and their subsequent analysis employing model atmospheres and the observation of the Kiso ultraviolet excess stars.

2029 **(N—88-25408) Ultraviolet spectra of two magnetic white dwarfs and ultraviolet spectra of subluminous objects found in the Kiso Schmidt survey. Final technical report, 1 January-31 December 1987.** Wegner, G.A. (Dartmouth Coll., Hanover, NH (USA)). Jul 1988. 22p. (NASA-CR—183051; NAS—1.26:183051). NTIS, PC A03/MF A01.

Research under NASA Grant NAG5-287 has carried out a number of projects in conjunction with the International Ultraviolet Explorer (IUE) satellite. These include: (1) studies of the UV spectra of DA white dwarfs which show quasi-molecular bands of H2 and H2(+); (2) the peculiar star HR6560; (3) the UV spectra of two magnetic white dwarfs that also show the quasi-molecular features; (4) investigations of the UV spectra of subluminous stars, primarily identified from visual wavelength spectroscopy in the Kiso survey of UV excess stars, some of which show interesting metal lines in their UV spectra; and (5) completion of studies of UV spectra of DB stars. The main result of this research has been to further knowledge of the structure and compositions of subluminous stars which helps cast light on their formation and evolution.

2030 **(N—88-25417) Superthermal electron processes in the upper atmosphere of Uranus: aurora and electroglow.** Waite, J.H. Jr.; Chandler, M.O.; Yelle, R.V.; Sandel, B.R. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1987. 51p. (NASA-TM—101150; NAS—1.15:101150). NTIS, PC A04/MF A01.

Strong ultraviolet emissions from the upper atmosphere of Uranus suggest that both auroral and electroglow phenomena are of significant aeronomical consequences in the structure of the upper atmosphere. Combined modeling and data analysis were performed to determine the effect of electroglow and auroral phenomena on the global heat and atomic hydrogen budgets in the Uranus upper atmosphere. The results indicate that the auroral and electroglow heat sources are not adequate to explain the high exospheric temperature observed at Uranus, but that the atomic hydrogen supplied by these processes is more than sufficient to explain the observations. The various superthermal electron distributions modeled have significantly different efficiencies for the various processes such as UV emission, heating, ionization, and atomic hydrogen production, and produce quite different H2 band spectra. However, additional information on the UV spectra and global parameters is needed before modeling can be used to distinguish between the possible mechanisms for electroglow.

2031 **(N—88-25423) 2-D magnetohydrostatic configurations leading to flares or quiescent filament eruptions.** An, C.H.; Suess, S.T.; Moore, R.L. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1988. 39p. (NASA-TM—101147; NAS—1.15:101147). NTIS, PC A03/MF A01.

To investigate the cause of flares and quiescent filament eruptions the quasi-static evolution of a magnetohydrostatic (MHS) model was studied. The results lead to a proposal that: the sudden disruption of an active-region filament field configuration and the accompanying flare result from the lack of a neighboring equilibrium state as magnetic shear is increased above the critical value; and a quiescent filament eruption is due to an ideal MHD kink instability of a highly twisted detached flux tube formed by the increase of plasma current flowing along the length of the filament. A numerical solution was developed for the 2-D MHS equation for the self-consistent equilibrium of a filament and overlying coronal magnetic field. Increase of the poloidal current causes increase of magnetic shear. As shear increases past a critical point, there is a discontinuous topological change in the equilibrium configuration. It was proposed that the lack of a neighboring equilibrium triggers a flare. Increase of the axial current results in a detached tube with enough helical twist to be unstable to ideal MHD kink modes. It was proposed that this is the condition for the eruption of a quiescent filament.

2032 **(N—88-25425) Observations of cosmic rays in the outer heliosphere.** Fillius, W. (California Univ., San Diego, La Jolla (USA)). 1986. 4p. (NASA-CR—182942; NAS—1.26:182942). NTIS, PC A02/MF A01.

Outward propagating cosmic ray modulation features seen in the outer heliosphere include Forbush decreases, the minimum of the 11 year cycle, and intervals of set recovery rate. The best theoretical model may not be the same for all these features. Some modulation features have been modified or have disappeared between Pioneer 11 and Pioneer 10 as if by the action of an interplanetary low-pass filter. Azimuthal symmetry still applies, and the radial gradient for nucleons is greater than approximately 500 MeV nucleon is approximately 1 percent AU.

2033 **(N—88-26271) Investigation of the diffuse ultraviolet background with DE data. Final technical report, 15 July 1986-14 January 1988.** Fix, J.D. (Iowa Univ., Iowa City (USA)). Jul 1988. 19p. (NASA-CR—182863; NAS—1.26:182863). NTIS, PC A03/MF A01.

The imaging instrumentation on the Dynamics Explorer 1 satellite is used to measure the intensity of the diffused ultraviolet radiation on two great circles about the sky. It was found that the extragalactic component of the diffuse ultraviolet radiation has an intensity of 530 + or - 15 units (a unit is one photon/(sq cm s A sr) at a wavelength of 150 nm. The galactic component of the diffuse ultraviolet radiation has a dependence on galactic latitude which requires strongly forward scattering particles if it is produced by dust above the galactic plane.

2034 **(N—88-26280) Kinetics of thermochemical gas-solid reactions important in the Venus sulfur cycle. Final report, 1 November 1985-31 October 1988.** Fegley, B. Jr. (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1988. 24p. (NASA-CR—182963; NAS—1.26:182963). NTIS, PC A03/MF A01.

The thermochemical net reaction $CaCO_3 + SO_2$ yields $CaSO_4 + CO$ is predicted to be an important sink for incorporation of SO_2 into the Venus crust. The reaction rate law was established to understand the dependence of rate on experimental variables such as temperature and partial pressure of SO_2, CO_2, and O_2. The experimental approach was a variant of the thermogravimetric method often employed to study the kinetics of thermochemical gas-solid reactions. Clear calcite crystals were heated at constant temperature in SO_2-bearing gas streams for varying time periods. Reaction rate was determined by three independent methods. A weighted linear least squares fit to all rate data yielded a rate equation. Based on the Venera 13, 14 and Vega 2 observations of CaO content of the Venus atmosphere, SO_2 at the calculated rate would be removed from the Venus atmosphere in about 1,900,00 years. The most plausible endogenic source of the sulfur needed to replenish atmospheric SO_2 is volcanism. The annual amount of erupted material needed for the replenishment depends on sulfur content; three ratios are used to calculate rates ranging from 0.4 to 11 cu km/year. This geochemically derived volcanism rate can be used to test if geophysically derived rates are correct. The work also suggests that Venus is less volcanically active than the Earth.

2035 **(N—88-26281) Rate of volcanism on Venus.** Fegley, B. Jr.; Prinn, R.G. (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1988. 12p. (NASA-CR—183039; NAS—1.26:183039). NTIS, PC A03/MF A01.

The maintenance of the global H_2SO_4 clouds on Venus requires volcanism to replenish the atmospheric SO_2 which is continually being removed from the atmosphere by reaction with calcium minerals on the surface of Venus. The first laboratory measurements of the rate of one such reaction, between SO_2 and calcite ($CaCO_3$) to form anhydrite ($CaSO_4$), are reported. If the rate of this reaction is representative of the SO_2 reaction rate at the Venus surface, then we estimate that all SO_2 in the Venus atmosphere (and thus the H_2SO_4 clouds) will be removed in 1.9 million years unless the lost SO_2 is replenished by volcanism. The required rate of volcanism ranges from about 0.4 to about 11 cu km of magma erupted per year, depending on the assumed sulfur content of the erupted material. If this material has the same composition as the Venus surface at the Venera 13, 14 and Vega 2 landing sites, then the required rate of volcanism is about 1 cu km per year. This independent geochemically estimated rate can be used to determine if either (or neither) of the two discordant (2 cu km/year vs. 200 to 300 cu km/year) geophysically estimated rates is correct. The geochemically estimated rate also suggests that Venus is less volcanically active than the Earth.

2036 **(N—88-26287) Ratio of microwaves to X-rays in solar flares: the case for the thick target model.** Lu, E.T.; Petrosian, V. (Stanford Univ., CA (USA)). Jun 1988. 25p. (NASA-CR—183102; NAS—1.26:183102; CSSA-ASTRO—88-08). NTIS, PC A03/MF A01.

The expected ratio of synchrotron microwave radiation to bremsstrahlung X-rays for thick target, thin target, and multithermal solar flare models is calculated. The calculations take into account the variation of the microwave to X-ray ratio with X-ray spectral index. The theoretical results are compared with observed ratios of a sample of 51 solar flares with well known spectral index. From this it is concluded that the nonthermal thick target model with a loop length of and order of 10 to the 9th power cm and a magnetic field of 500 + or - 200 G provides the best fit to the data. The thin target and multithermal models require unreasonably large density or pressure and/or low magnetic field to match the data.

2037 **(N—88-27137) Experimental study of planetary gases with applications to planetary interior models. Final project report, 1 June 1983-30 November 1987.** Bell, P.M.; Mao, H.K. (Carnegie Institution of Washington, DC (USA)). Aug 1988. 10p. (NASA-CR—183098; NAS—1.26:183098). NTIS, PC A02/MF A01.

High-pressure experimental data on planetary materials are critical in developing planetary models and in addressing otherwise insoluble problems of the internal structure of the major planets. Progress in the last five years has been particularly marked. Maximum static pressure of 550 GPa was achieved. For the first time, X-ray diffraction of solidified gases (Ne, Xe) and ices (H2O) were obtained at pressures above one megabar, single-crystal diffraction of ultralight elements (H2, He) were detected up to 25 GPa, pressures over 200 GPa at 77 K were reached in solid hydrogen, including the discovery of a phase transformation in the molecular solid. Advances in instrumentation and new measurements performed during 1983 to 1988 are summarized.

2038 **(N—88-27144) Hard x-ray burst spectrometer event listing 1980-1987.** Dennis, B.R.; Orwig, L.E.; Kiplinger, A.L.; Schwartz, R.A.; Gibson, B.R.; Kennard, G.S.; Tolbert, A.K.; Biesecker, D.A.; Labow, G.J.; Shaver, A. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Feb 1988. 158p. (NASA-TM—4036; REPT—88B0124; NAS—1.15:4036). NTIS, PC A08/MF A01.

This event listing is a comprehensive reference for the Hard X-ray bursts detected with the Hard X-ray Burst Spectrometer on the Solar Maximum Mission from the time of launch 14 February 1980 to December 1987. Over 8600 X-ray events were detected in the energy range from 30 to approx. 600 keV with the vast majority being solar flares. The listing includes the start time, peak time, duration and peak rate of each event.

2039 **(N—88-27146) Research in particle and gamma-ray astrophysics. Semiannual status report, 1 April 1987-31 March 1988.** Stone, E.C.; Davis, L. Jr.; Mewaldt, R.A.; Prince, T.A. (California Inst. of Tech., Pasadena (USA)). Aug 1988. 25p. (NASA-CR—183111; NAS—1.26:183111). NTIS, PC A03/MF A01.

This research program is directed toward the investigation of the astrophysical aspects of cosmic rays and gamma rays and of the radiation and electromagnetic field environment of the Earth and other planets. The emphasis was on precice measurements with high resolution in charge, mass and energy. These investigations were carried out by means of energetic particle and photon detector systems flown on spacecraft and balloons.

2040 **(PB—88-236518/XAB) Solar-Geophysical Data Number 525, May 1988: Part 1 (prompt reports). Data from April 1983, March 1988 and late data.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). May 1988. 157p. (SGD—525-PT-1). NTIS, PC A08/MF A01.

See also Part 2, PB—88-237003 and PB—87-181194.

Contents include: detailed index for 1987 and 1988; data for April 1988 -- (IUWDS alert periods (advance and worldwide), solar-activity indices, solar flares, solar radio emission, Stanford mean solar magnetic field); data for march 1988 -- (solar-active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic-ray measurements by neutron monitor, geomagnetic indices, radio-propagation indices); late data-- (Pioneer XII solar wind -- February 1984-December 1987, calcium-plage data).

2041 **(PB—88-237003/XAB) Solar-Geophysical Data Number 525, May 1988. Part 2 (comprehensive reports). Data for November 1987, and miscellanea.** Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). May 1988. 98p. (SGD—525-PT-2). NTIS, PC A05/MF A01.

See also Part 1, PB—88-236518 and PB—87-181202.

Contents include: detailed index for 1987 and 1988; data for November 1987 -- (Meudon carte synoptique, solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from GOES satellite, mass ejections from the sun, active prominences and filaments); miscellaneous data -- interplanetary solar particles and plasma -- (IMP 8 solar wind -- October 1987 - January 1988, IMP 8 solar particles -- September 1985 - May 1986).

2042 **(PB—88-238811/XAB) Space Environment Laboratory. Annual report - fy 1987, October 1, 1986 to September 30, 1987.** (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Space Environment Lab.). Jan 1988. 46p. NTIS, PC A03/MF A01.

See also rept. for FY 1986, PB—87-208666; Color illustrations reproduced in black and white.

This annual report documents some of the major activities undertaken in FY 1987 by NOAA's Space Environment Lab. The reader is reminded that space-environment disturbances are pseudocyclical in their characteristics, having about an 11-year period commensurate with the 11-year sunspot cycle. The advances in systems and research documented here will stand SEL in good stead during the next several years, as disturbances reach their peak levels with sunspot maximum. However, there are many areas still needing improvement, some of which are discussed in the report.

2043 **(SLAC-PUB—4734) Wormholes and cosmology.** Klebanov, I.; Susskind, L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1988. Contract AC03-76SF00515. 8p. (CONF-8808145—1). NTIS, PC A02/MF A01. Order Number DE89002074/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

We review Coleman's wormhole mechanism for the vanishing of the cosmological constant. We find a discouraging result that wormholes much bigger than the Planck size are generated. We also consider the implications of the wormhole theory for cosmology. 7 refs., 2 figs.

2044 **(UCRL—99582) Kinetic simulation of magnetic reconnection in the presence of shear.** Francis, G.E.; Hewett, D.W.; Max, C.E. (Lawrence Livermore National Lab., CA (USA)). 5 Sep 1988. Contract W-7405-ENG-48. 6p. (CONF-8809173—1). NTIS, PC A02/MF A01. Order Number DE89001717/JAW.

From International workshop on reconnection in space plasma; Potsdam, German D.R. (5 Sep 1988).

The basic physical processes associated with collisionless magnetic reconnection are investigated using the implicit PIC code AVANTI. The code is based on a 2.5-D fully electromagnetic direct implicit algorithm which has proven stable for arbitrary time step. This stability makes it possible to separate out the respective roles of the highly magnetized electrons and the un-magnetized ions for large ion-electron mass ratios. It is found that the inclusion of a guide magnetic field (magnetic shear) severely slows the initial stages of reconnection and damps out the electrostatic ringing if local values of the guide field are above a threshold determined by questions of electron mobility. 9 refs., 6 figs.

2045 **Calculation of low-energy atmospheric muon flux.** Lee, H.; Bludman, S.A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 9, 2906-2907(1 Nov 1988).

We report the results of a three-dimensional Monte Carlo calculation of the low-energy atmospheric muon flux. They agree with the experiments by Allkofer et al. at sea level, but the agreement with the experiments by Conversi at a high altitude is not good, particularly at a very high altitude.

2046 **Electron heating and the potential jump across fast mode shocks.** Schwartz, S.J.; Thomsen, M.F.; Bame, S.J.; Stansberry, J. (Astronomy Unit, School of Mathematical Sciences, Queen Mary College, London). *Journal of Geophysical Research;* **93**: No. A11, 12923-12931(1 Nov 1988).

The electron heating and the electrostatic potential jump across collisionless shocks play an important, if not dominant, role in the electron momentum balance. We present here a survey of these two quantities over a large sample of fast mode collisionless shocks. Results for estimates of the electrostatic potential (as measured in the de Hoffmann-Teller reference frame) based on an estimate of the jump in electron enthalpy and on Liouville's theorem correlate well with each other, although the latter are consistently higher, perhaps due to irreversible processes affecting the shock electron dynamics. The size of the potential does not appear to be strongly controlled by any of the various upstream parameters (shock geometry, Mach number etc.,) and represents approximately 12% of the incident ion ram kinetic energy, this figure showing some tendency to heating across the shock varies systematically from 50% or more at subcritical Mach numbers to less than 10% at the highest Mach number shocks in the sample. The electron heating shows only modest, but systematic, departure from that which would result by perserving the ratio of the perpendicular temperature to the magnetic field strength. copyright American Geophysical Union 1988

2047 **Neutrino-induced r-process nucleosynthesis.** Epstein, R.I.; Colgate, S.A.; Haxton, W.C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **61**: No. 18, 2038-2041(31 Oct 1988).

We propose that the r-process elements may be synthesized in the helium zones surrounding a newly forming neutron star. Neutrinos released from a cooling neutron star produce neutrons (and other nuclides) by neutral-current excitations of ^{4}He. If the neutron-star progenitor is metal-poor, compact, or both, the flux of free neutrons is sufficiently intense and of long enough duration to generate an r process.

2048 **Subcritical dispersive shock waves upstream of planetary bow shocks and at comet Giacobini-Zinner.** Omidi, N.; Winske, D. (Institute of Geophysics and Planetary Physics, Univeristy of California at Los Angeles). *Geophysical Research Letters;* **15**: No. 11, 1303-1306(Oct 1988).

Electromagnetic simulations are used to investigate the nonlinear evolution of ULF (magnetosonic) waves. These waves have been observed upstream of planetary bow shocks and at Comet Giacobini-Zinner. The simulations show that these waves steepen to form subcritical dispersive shock waves. The steepening process is due to the generation of a broad spectrum of waves on the magnetosonic-whistler branch. As a result, the waveform spreads in space and the original elliptical polarization of the wave changes to linear. Also, the fastest propagating waves overtake the steepened front and form a circularly polarized precursor. Interpretation of the steepened waves as shocks suggest that Comet Giacobini-Zinner did not have a single bow shock but instead a transition region consisting of a series of shocks which were convected by the solar wind. copyright American Geophysical Union 1988

2049 **Angular momentum distribution in galactic halos.** Quinn, P.J.; Zurek, W.H. (Space Telescope Science Institute, Baltimore, MD (USA); Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **331**: 1-18(Aug 1988).

N-body simulations are used to model the formation of individual galactic halos from scale-free density perturbations in universes dominated by cold, nondissipative dark matter. In well-mixed halos, the angular momentum distribution is shown to have a systematic behavior with power law index n corresponding to that found for circular rotation curves. For a given n, the distribution of angular momentum has the same trend with radius and energy as that implied for a halo in which all the matter has its maximum possible angular momentum. Dynamical mixing during the relaxation of the halo redistributes both angular momentum and binding energy in an orderly manner. The organized nature of the collapse means that relaxation is not completely violent and that the secondary infall paradigm, in its simplest form, needs to be modified to

include the organizing effects of dynamical friction. It is shown that the Mestel hypothesis is not consistent with the final collapsed state of halos, but may be applicable to the collapse of the disks of spirals. 29 references.

2050 **Primordial nucleosynthesis with decaying particles. I. Entropy-producing decays. II. Inert decays.** Scherrer, R.J.; Turner, M.S. (Chicago Univ., IL (USA); NASA/Fermi National Accelerator Laboratory, Batavia, IL (USA)). *Astrophysical Journal;* **331**: 19-37(Aug 1988).

The effect of a nonrelativistic particle X, which decays out of equilibrium, on primordial nucleosynthesis is investigated, including both the energy density of the X particle and the electromagnetic entropy production from its decay. The results are parametrized in terms of the X particle lifetime and the density parameter rm(X), where m(X) is the X particle mass and r is the ratio of X number density to photon number density prior to nucleosynthesis. The results rule out particle lifetimes greater than 1-10 s for large values of rm(X). The question of a decaying particle which produces no electromagnetic entropy in the course of its decay is addressed, and particles which produce both entropy and an inert component in their decay are discussed. 55 references.

2051 **C_2H in the 2 micron infrared spectrum of IRC +10216.** Keady, J.J.; Hinkle, K.H. (Los Alamos National Lab., NM (USA); Kitt Peak National Observatory, Tucson, AZ (USA)). *Astrophysical Journal;* **331**: 539-546(Aug 1988).

Nearly 30 lines of C_2H in two bands at 4011 and 4108/cm have been identified in the 2 micron spectrum of IRC +10216. A rotational temperature of about 12.5 + or - 1.5 K and a column density of about 3 X 10 to the 15/sq cm have been found. Modeling the lines with an observer's frame radiative transfer code indicates that the peak radial abundance of C_2H relative to H_2 is about 0.00001-0.000001, and that the C_2H is concentrated about 8 X 10 to the 16 cm away from the central infrared source. A model including photodissociation by interstellar UV demonstrates that all the observed C_2H can be formed in the circumstellar shell by photolysis of C_2H_2. It is suggested that the radial abundance of C_2H_2 decreases by at least a factor of 5, perhaps by accretion of C_2H_2 onto grains, from about 100 solar radii to about 1000 solar radii, where photodissociation begins. 39 references.

2052 **Rotation of halos in open and closed universes - differentiated merging and natural selection of galaxy types.** Zurek, W.H.; Quinn, P.J.; Salmon, J.K. (Los Alamos National Lab., NM (USA); Space Telescope Science Institute, Baltimore, MD (USA); California Institute of Technology, Pasadena (USA)). *Astrophysical Journal;* **330**: 519-534(Jul 1988).

Computer simulations are used here to study the properties of galactic halos formed from Gaussian initial density perturbations in both open and closed dark matter universes. It is shown that if galaxies form through gravitational collapse from initial, Gaussian density perturbations, then their luminous parts do not have the original values of either specific angular momentum (ellipticals) or spin parameter lambda (spirals). The rotational properties of a halo depend only weakly on either the halo density or the density of its environment. Variations of the large-scale density of the environment have an expected, dramatic effect on the density of individual halos. Dissipationless merging forces the cores of the merging objects into the core of the merger product. In the process, cores become more bound and lose angular momentum. These findings are extrapolated to propose a model for galaxy formation in which both ellipticals and spirals come into being through mergers. 59 references.

2053 **2.2 second period in the 1984 August 5 gamma-ray burst.** Kouveliotou, C.; Desai, U.D.; Cline, T.L.; Dennis, B.R.; Fenimore, E.E. (NASA, Goddard Space Flight Center, Greenbelt, MD (USA); Los Alamos National Lab., NM (USA)). *Astrophysical Journal;* **330**: L101-L105(Jul 1988).

A time history and Fourier power spectrum are presented for the August 5, 1984 gamma-ray burst (GRB) observed with the SMM Hard X-ray Burst Spectrometer and the Pioneer Venus Orbiter spacecraft. A significant complex feature of the event is identifiable in both data sets: a gradual ripple with a well-defined 2.2-sec period lasting for seven cycles, with a series of narrow spikes, which appear always on the ascending phase of the sinusoidal ripple. This event is unusual in both its temporal and spectral attributes: it exhibits coexistence of periodic and nonperiodic features, and it was also reported as the most intense GRB event observed with the SMM Gamma-Ray Spectrometer, extending up to 100 MeV. 12 references.

2054 **Average configuration of the induced Venus magnetotail.** Mccomas, D.J.; Spence, H.E.; Russell, C.T. pp 389-392 of Magnetotail physics. Lui, A.T.Y. Baltimore, MD; Johns Hopkins University Press (1987).

The interaction of the solar-wind flow with Venus is discussed as well as the morphology of magnetic-field-line draping in the Venus magnetotail. Emphasis is placed on the importance of the interplanetary magnetic field X-component in controlling the configuration of field draping in this induced magnetotail. The average magnetic configuration of this magnetotail is studied. A connection is made between the derived consistent plasma flow speed and density and the observational energy/charge range and sensitivity of the Pioneer Venus Orbiter plasma analyzer. 7 references.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 2040

2055 (ACIESP—60-Vol.1, pp 107) **Energetic electron precipitation at the South Atlantic magnetic anomaly: a review.** Pinto Junior, O.; Gonzalez, W.D. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2056 (ACIESP—60-Vol.1, pp 109) **Measurements of VLF wave-particle interactions at the South Atlantic magnetic anomaly on board a Brazilian geophysical satellite.** Gonzalez, W.D.; Pinto Junior, O.; Dutra, S.L.G.; Takahashi, H. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2057 (ACIESP—60-Vol.1, pp 110) **High energy electron and proton observations in the South Atlantic geomagnetic anomaly.** Nakamura, Y.; Takahashi, H.; Nagata, K.; Kohno, T.; Murakami, H. (Institute of Space and Astronautical Science, Tokyo (Japan); Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil); Tamagawa Univ., Machida, Tokyo (Japan); Institute of Physical and Chemical Research, Wako, Saitama (Japan)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2058 (ACIESP—60-Vol.1, pp 112) **Investigations on the midnight formation of ionospheric bubbles.** Bonelli, E.; Medeiros, R.T. de; Borba, G.L. (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2059 (ACIESP—60-Vol.1, pp 113) **Intensity maps of energetic electrons and protons in the altitude range of 350-850 Km.** Kohno, T.; Munakata, K.; Nagata, K.; Murakami, H.; Nakamoto, J.; Hasebe, N.; Kikuchi, J.; Doke, T. (Institute of Physical and Chemical Research, Wako, Saitama (Japan); Tamagawa Univ., Machida, Tokyo (Japan); Rikkyo Univ., Tokyo (Japan). Faculty of Science; Ehime Univ., Matsuyama (Japan)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2060 (ACIESP—60-Vol.1, pp 114) **Large nighttime ionospheric F-region trace constituent concentration as observed through incoherent scatter technique at the Arecibo Observatory.** Sobral, J.H.A.; Zamlutti, C.J.; Paula, E. de. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2061 (ACIESP—60-Vol.1, pp 115) **Overview of the equatorial electrojets theoretical grounds.** Zamlutti, C.J.; Sobral, J.H.A.; Abdu, M.A. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2062 (ACIESP—60-Vol.1, pp 116) **Behavior of electron temperature in the South Atlantic magnetic anomaly.** Oyama, K.-I.; Abe, T.; Watanabe, S. 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2063 (ACIESP—60-Vol.1, pp 118) **Radiowave absorption measurement near geomagnetic anomaly region during a magnetic storm.** Rao, K.R.; Pardo, P.R.N.; Trivedi, N.B.; Costa, J.M. da. (Fundacao Universidade Regional de Blumenau (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2064 (ACIESP—60-Vol.1, pp 118) **Medium frequency radiowave absorption at sunrise and sunset times in the geomagnetic anomaly region.** 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2065 (ACIESP—60-Vol.1, pp 121) **Electromagnetic radiation emitted by the stimulated plasma resonance in the active experiment in space.** Chian, A.C.-L. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2066 **(AD-A—195841/2/XAB) Formulating a simple D-region model. Environmental research papers.** Swider, W. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 28 Oct 1987. 19p. (AFGL-TR—87-0308). NTIS, PC A03/MF A01.

This report focuses on a body of work that suggests that the effective recombination coefficients in the daytime D region are fairly invariant and thus lead to a rather simple solution for the electron concentrations. In addition, a quadratic expression is available for the estimation of electron concentrations at night. The ionization production rate q must be known and incorporated into the chemistry of the D region to determine electron concentrations (e) as a function of altitude. There is some D-region research that supports a simple way to determine (e) once q is known. Thus, the daytime effective recombination coefficient, Psi, appears to be relatively insensitive to q and can provide for the determination of (e), (e) = sq rt(q/Psi) under steady-state conditions. For steady-state conditions at night, an equation exists that yields (e) with reasonable accuracy.

2067 **(AD-A—195848/7/XAB) Ionosonde studies of field-aligned irregularities during high-power h-f heating at Arecibo.** McNamara, L.F.; Reinisch, B.W.; Buchau, J. (Lowell Univ., MA (USA). Center for Atmospheric Research). Feb 1988. 46p. (ULRF—433/CAR). NTIS, PC A03/MF A01.

Backscatter ionograms recorded by an airborne digital ionosonde during the September 1981 ionospheric h-f heating campaign at Arecibo were simulated using simplified ionospheric models and analytic raytracing techniques. The simulations indicate that irregularities were created at all altitudes from the interaction height (where the plasma frequency was equal to the heater frequency down to the base of the F layer, but with a preferred altitude near the interaction height. There was no evidence for the existence of irregularities at altitudes much above the interaction height. The horizontal east/west extent of the irregularity patch was approximately 100 to 150 km, shifted towards the west with respect to the Arecibo magnetic meridian (asymmetry 25 km to the east/125 km to the west).

2068 **(AD-A—195972/5/XAB) Investigations of magnetosphere-ionosphere coupling relevant to operational systems. Final scientific report, 1984-1987.** Meng, C.I.; Newell, P.T. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Feb 1988. 105p. NTIS, PC A06/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

Important advances were made in understanding the dynamics of the magnetosphere and its coupling to the ionosphere. Significant progress was made in the areas of polar cusp precipitation and dynamics; dayside auroral morphology and auroral boundary dynamics; polar rain; the quiescent polar cap; the physics of impulsive injection phenomena; and problems of global magnetospheric plasma transport.

2069 **(AD-A—195980/8/XAB) Utilization of ionosonde data to analyze the latitudinal penetration of ionospheric storm effects.** Forbes, J.M.; Codrescu, M.; Hall, T.J. (Boston Univ., MA (USA)). Mar 1988. 7p. NTIS, PC A02/MF A01.

Pub. in Geophysical Research Letters, Vol. 15, No. 3, 249-252(Mar 1988). Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

Increased emphasis is placed on global coupling between the magnetosphere, ionosphere, and thermosphere systems, particularly with regard to the penetration of dynamic, chemical, and electrodynamic effects from high to low latitudes during magnetically disturbed periods. An emerging potential exists for latitudinal and longitudinal chains of ionosondes to contribute uniquely to this thrust in ways complementary to the capabilities and shortcomings of other groundbased sensors and satellites. Here is illustrated a methodology to realize the fullest potential of such ionosonde data. Hourly values are fit in latitude using Legendre polynominals, and variations from quiet time values are displayed in latitude - U.T. coordinates using a color graphics method which provides an illuminating illustration of the penetration of ionospheric disturbances in latitude and their dependence on Kp, storm time, and local time. Observed effects are interpreted in terms of plausible electric field, neutral wind, and neutral composition changes during the storm period. Besides reflecting the anticipated southward flows and equatorward extensions in conjunction with magnetically disturbed conditions, the 24-hour average meridional winds exhibit a northward return flow after the magnetic disturbance has relaxed.

2070 **(AD-A—196016/0/XAB) Evaluation of space plasma data: effects upon spacecraft materials and predictions. Final report, 10 October 1982-20 January 1984.** Winningham, J.D. (Southwest Research Inst., San Antonio, TX (USA)). Sep 1984. 12p. NTIS, PC A03/MF A01.

A complete LAPI and DE data analysis package was developed through which data from all DE-2 experiments can be plotted on a common time scale. The analysis package was implemented on a MASSCOMP 500 computer system. Analysis of space-plasma data has shown the processes occuring within the magnetosphere lead to large temporal and spatial variations in the space plasma. These variations can and do have a large impact on space systems. The studies undertaken are leading to a better environmental understanding with the ultimate goal being how to mitigate the effects.

2071 **(AD-A—196228/1/XAB) Particle trajectories and potentials in a plane sheath moving in a magnetoplasma. Environmental research papers.** Dubs, C.W.; Cooke, D.L. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 15 Jul 1987. 40p. (AFGL-TR—87-0225). NTIS, PC A03/MF A01.

A plane sheath moving in the direction of its normal across the magnetic field through a magnetoplasma is analyzed. The self-consistent analytic solution for solution for electric field and trajectories of univelocity-attracted particles as a function of sheath-edge entry angle is derived. For simplicity, the sheath edge is assumed to be sharp. The solution is similar to that for a planar magnetron found much earlier. A quantity q, the square of the ratio of plasma frequency to gyrofrequency, is found to be critical in the behavior of the attracted species. If it is more than a limiting (cutoff) value, am, that depends only on entry angle and Mach number, M, the particles penetrate the whole sheath, some or all of the particles return to the sheath edge. In the frame of the object plane, for $M<<1$, q/sub m/ is 1.2(2M) at vertical and infinity at grazing incidence; for $M=1$, q/sub m/ = 1; for $M>>1$, q sub m is 1.2. So the effect of magnetic field can increase greatly for drift velocity much less than thermal speed. The range of entry angles is derived. For typical low earth orbit conditions, electrons enter between grazing incidence and 45^0, and have a value of q less than a third of q sub m , whereas 0+ ions enter within 7^0 of vertical incidence and have a value of q over 10^5 power times larger than q/sub m/. So the magnetic field effects the electrons greatly but the ions only very slightly.

2072 **(INIS-BR—1274) X and gamma ray backgroud observations in Antarctic.** Jayanthi, U.B. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. 8p. (CONF-8804212—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704347/JAW.

From 1. seminar on atmospheric and spatial sciences of the Brazilian Antarctic Program; Sao Jose dos Campos, Brazil (27 Apr 1988).

Atmospheric X amd gamma rays are products of complex electromagnetic interation between charged particles and atmospheric constituents. The latitudinal dependence of the cosmic rays secondaries, auroral and South Atlantic Anomaly phenomena produce flux variations, especially the later temporal flux variations. We propose to discuss these variations in relevance to balloon flight observations of X and gamma ray atmospheric background at polar latitudes.

2073 **(N—88-24120) Centrifugal acceleration of ions in the polar magnetosphere.** Swinney, K.R.; Horwitz, J.L.; Delcourt, D. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Mar 1987. 36p. (NASA-TM—101148; NAS—1.15:101148). NTIS, PC A03/MF A01.

The transport of ionospheric ions originating near the dayside cusp into the magnetotail is parametrically studied using a 3-D model of ion trajectories. It is shown that the centrifugal term in the guiding center parallel force equation dominates the parallel motion after about 4 Re geocentric distance. The dependence of the equatorial crossing distance on initial latitude, energy and convection electric field is presented for ions originating on the dayside ionosphere in the noon-midnight plane. It is also found that up to altitudes of about 5 Re, the motion is similar to that of a bead on a rotating rod, for which a simple analytical solution exists.

2074 **(N—88-25996) Dynamics explorer data analysis. Semiannual Report, 15 May 1987-15 May 1988.** Reiff, P.H. (Rice Univ., Houston, TX (USA)). Jul 1988. 8p. (NASA-CR—181428; NAS—1.26:181428). NTIS, PC A02/MF A01.

The project has shown unambiguously that auroral acceleration is caused by electric fields aligned parallel to the Earth's magnetic field. Evidence was shown of significant ion heating as ions are accelerated upwards in auroral electric fields. This heating is most likely caused by the two-stream instability. The fate of upward ion beams associated with auroral arcs is shown; they appear in the opposite hemisphere as dispersive ion precipitation events. Magnetic merging of the Interplanetary Magnetic Field occurs with both closed dayside magnetospheric field lines and open tail lobe field lines simultaneously nearly 30 percent of the time. The sunward flow in the dawnside plasma sheet is 20 percent smaller, on average, than in the duskside. The convection throat is displaced slightly more toward dawn for B sub y greater than 0 than for B sub y less than 0.

2075 **SW UMa and V426 Oph: EXOSAT surprises.** Szkody, P. Seattle, WA; Washington University (1988). 5p. NTIS, PC A02/MF A01.

EXOSAT results on the dwarf nova SW UMa and the nova-like V426 Oph earmark these objects as unusual cataclysmic variables (CV). SW UMa is a strong soft (0.07 to 0.21 keV) source for its faint optical magnitude (V = 16.5), but shows no evidence for a harder (greater than 10 keV) component. The soft component is modulated at the orbital period (82 min) with the peak emission at phase 0.3, coincident with optical and spectroscopic modulations. V426 Oph is a strong medium energy source (30 keV) and shows a modulation at a one hour timescale during its 6 hour orbit, implying a possible DQ Her type system.

2076 **Bidirectional electron anisotropies in the distant tail - ISEE 3 observations of polar rain.** Baker, D.N.; Bame, S.J.; Feldman, W.C.; Gosling, J.T.; Zwickl, R.D.; Slavin, J.A.; Smith, E.J. pp 47 of Magnetotail physics. Lui, A.T.Y. Baltimore, MD; Johns Hopkins University Press (1987).

A detailed observational treatment of bidirectional electrons (50 approx. 500 eV) in the distant magnetotail (or greater than or equal to 100 R sub E) is presented. It is found that electrons in this energy range commonly exhibit strong, field aligned anisotropies in the tail lobes. Because of large tail motions, the ISEE-3 data provide extensive sampling of both the north and south lobes in rapid succession, demonstrating directly the strong asymetries that exist between the north and south lobes at any one time. The bidirectional fluxes are found to occur predominantly in the lobe directy connected to the sunward IMF in the open magnetosphere model (north lobe for away sectors and south lobe for toward sectors). Electron anisotropy and magnetic field data are presented which show the transition from unidirectional (sheath) electron populations to bidirectional (lobe) populations. Taken together, the present evidence suggests that the bidirectional electrons that we observe in the distant tail are closely related to the Polar rain electrons observed previously at lower altitudes. Furthermore, these data provide strong evidence that the distant tail is comprised largely of open magnetic field lines in contra distinction to some recently advanced models. 16 references.

2077 **Plasma and magnetic field variations in the distant magnetotail associated with near-earth substorm effects.** Baker, D.N.; Bame, S.J.; Mccomas, D.J.; Zwickl, R.D.; Slavin, J.A.; Smith, E.J. pp 137-142 of Magnetotail physics. Lui, A.T.Y. Baltimore, MD; Johns Hopkins University Press (1987).

Examination of many individual event periods in the ISEE 3 deep-tail data set has suggested that magnetospheric substorms produce a characteristic pattern of effects in the distant magnetotail. During the growth, or tail-energy-storage phase of substorms, the magnetotail appears to grow diametrically in size, often by many earth radii. Subsequently, after the substorm expansive phase onset at earth, the distant tail undergoes a sequence of plasma, field, and energetic-particle variations as large-scale plasmoids move rapidly down the tail following their disconnection from the near-earth plasma sheet. ISEE 3 data are appropriate for the study of these

effects since the spacecraft remained fixed within the nominal tail location for long periods. Using newly available auroral electrojet indices (AE and AL) and Geo particle data to time substorm onsets at earth, superposed epoch analyses of ISEE 3 and near-earth data prior to, and following, substorm expansive phase onsets have been performed. These analyses quantify and extend substantially the understanding of the deep-tail pattern of response to global substorm-induced dynamical effects. 15 references.

2078 **Energetic ion and electron beams at the plasma-sheet boundary in the distant tail.** Scholer, M.; Klecker, B.; Hovestatd, D.; Gloeckler, G.; Ipavich, F.M.; Galvin, A.B.; Baker, D.N.; Tsurutani, B.T. pp 245-249 of Magnetotail physics. Lui, A.T.Y. Baltimore, MD; Johns Hopkins University Press (1987).

Several energetic particle bursts observed by ISEE 3 in the distant tail are analyzed. The energetic particle data are supplemented by the electron plasma and magnetic field measurements. These bursts are characterized by large velocity-dispersion effects, with energetic electrons observed first, followed by ions with continuously lower velocities. Both ions and electrons stream in the tailward direction. Protons and alpha particles of the same energy per nucleon are observed at the same time. The dispersion effects are observed in reverse order when the spacecraft leaves from the boundary layer into the lobe. No obvious signature indicating the passage of a plasmoid has been observed in the particle or magnetic field data during or immediately following these bursts. It is concluded that these beams at the plasma-sheet boundary originate at a steady source, presumably close to a neutral line, and not at a time varying source. The velocity filter effect in a dawn-dusk electric field arranges particles with progressively lower velocity further inside the wedge-shaped region of reconnected field lines. The plasma electron distribution exhibits a tailward directed heat flux within this layer. 15 references.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 1197, 1199, 2247, 2410, 2422, 2426, 2482

2079 **(AD-A—195575/6/XAB) Observation of spatially localized atomic-electron wave packets.** Yeazell, J.A.; Stroud, C.R. (Rochester Univ., NY (USA). Inst. of Optics). 11 Apr 1988. 5p. NTIS, PC A02/MF A01.

Pub. in Physical Review Letters, Vol. 60, No. 15, 1494-1497(11 Apr 1988).

This reprint explores the excitement and detection of an atomic-electron wave packet that is localized in the polar and azimuthal angles. The wave packet is formed through the coherent superposition of Rydberg states of atomic sodium. The superposition is achieved by short-pulse optical excitation of the atom in the presence of a strong r-f field. The wave packet is detected by d-c field ionization. The behavior of this wave packet in a strong dc field is much different from that of an eigenstate. This behavior agrees well with a simple classic model.

2080 **(AD-A—196022/8/XAB) Dissociative electron attachment to rovibrationally excited molecules. Annual technical report No. 3 (Final) 1 September 1984-31 August 1987.** Wadehra, J.M. (Wayne State Univ., Detroit, MI (USA). Dept. of Physics and Astronomy). 31 Aug 1987. 135p. NTIS, PC A07/MF A01.

The primary aim of this project is to investigate the role played by the initial rovibrational excitation of a molecule in enhancing the cross sections and, therefore, the rates of dissociative electron attachment to the molecule. An enhancement of the attachment rate results in the enhancement of the production of negative-ion beams. The processes of dissociative electron attachment and of resonant vibrational excitation are complementary processes as the intermediate resonant-anion state of the molecule, formed by electron impact, either can autodetach the electron or can dissociate itself. Therefore, as a further part of the investigations excitation of the molecule was explored. The first project was to study the effect of initial vibrational excitation on the rates of production of negative atomic lithium ions via the process of dissociative electron attachment of lithium dimers.

2081 **(AD-A—196717/3/XAB) Rate constants for quenching the A 2A2 state of SO_2i by atmospheric gases.** Thomas, T.F.; Dale, F.; Paulson, J.F. (Missouri Univ., Kansas City (USA). Dept. of Chemistry). 1 May 1988. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Chemistry Physics, Vol. 88, No. 9, 5553-5560(1 May 1988).

In the course of obtaining the ion photodissociation spectrum of SO_2^+, which we have recently reported in this Journal, we have observed that the measured cross sections for photodissociation in the visible region were dependent upon the pressure of SO_2 used in the ion source. Since our previous work using the same ion source had shown no pressure effect on the photodissociation cross sections of N_2O^+, this observation was unexpected. At source pressures in the 0.01 to 0.10 Torr range (approx. 30 x the pressure used in gathering our previous SO_2^+ data) a significant effect on the photodissociation spectrum of Ar_2^+ had previously been observed in the same ion source, however. This effect was interpreted in terms of collisional deactivation of vibrationally excited Ar_2^+ with a rate constant approx. 12% of Langevin. Thus, the pressure effect seen for SO_2^+ indicated some deactivation process occurring at a rate exceeding the theoretical upper limit for ion-molecular reactions. It therefore seemed important to make a systematic study of the processes involved and their precise rate constants.

2082 **(AD-A—196754/6/XAB) Electron and photon transport calculations between 1 MeV and 1 eV. Final report, November 1982-May 1986.** Woolf, S. (Arcon Corp., Waltham, MA (USA)). Apr 1988. 76p. NTIS, PC A05/MF A01.

This report describes the development and application of numerical methods for predicting dose and variation in multi-layered structures due to x rays and gamma rays and the charge buildup in dielectrics due to electron-beam irradiation. The scope of the work included: development and implementation of: 1) discrete-ordinates electron-transport calculations for electron sources both within and incident of solid structures; 2) discrete-ordinates electron-transport calculations for photon sources incident on layered solids; and 3) Monte Carlo calculations and statistical analysis programs for low-energy electron transport in insulating structures. In addition, several photon-transport calculations were made to determine the scattered-photon energy spectra characteristic of various standard irradiation test facilities.

2083 **(CONF-861038—12) Dynamics of cluster dissociation.** Keesee, R.G.; Castleman, A.W. Jr. (Pennsylvania State Univ., University Park (USA)). 1986. Contract AC02-82ER60055. 7p. NTIS, PC A02/MF A01. Order Number DE89001559/JAW.

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

The dynamics of dissociation of clusters induced by multiphoton ionization (MPI) is examined by time-of-flight mass spectrometry with the aid of a reflecting electric field. The systems discussed include ammonia, methanol, xenon, and p-xylene(Ar)/sub n/ clusters. Ammonia and methanol clusters undergo rapid intracluster reactions to yield protonated clusters. Much of the excess energy which leads to dissociation in ammonia, methanol, and xenon clusters results from the energy differences in the ground states of the neutral and ionic systems. On the other hand, in the case of p-xylene(Ar)/sub n/ the energetic differences are much smaller, so that the excess absorbed photon energy may be an important contribution. 10 refs., 3 figs.

2084 **(CONF-881151—16) Charge and angular correlated inelasticities in MeV/nucleon ion-atom collisions.** Schoene, H.; Schuch, R.; Datz, S.; Dittner, P.F.; Giese, J.P.; Krause, H.F.; Schulz, M.; Kessel, Q.C. (Oak Ridge National Lab., TN (USA); Forskningsinstitutet foer Atomfysik, Stockholm (Sweden); Connecticut Univ., Storrs (USA). Dept. of Physics). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01. Order Number DE89001577/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

Using an Elbek high-resolution magnetic spectrograph, we measured energy loss an angular distributions of MeV/nucleon projectile ions in coincidence with target recoil-ion charge state. We investigated collisions of 10 and 20 MeV C^{6+} on He, Ne, Ar, and Kr where the target atom is multiply ionized and the projectile emerges in charge state q or q-1. The amount of energy transferred to the continuum electrons exceeds, by far, the sum of the values of the ionization potentials and shows a strong target Z dependence. Both an n-body classical-trajectory Monte Carlo method (nCTMC) and an energy deposition model are used for comparison with the experimental data. 12 refs., 3 figs.

2085 **(CONF-881151—17) Transfer and excitation processes studied in H-like S and Li-like and H-like F colliding with H_2.** Schulz, M.; Datz, S.; Dittner, P.F.; Giese, J.P.; Krause, H.F.; Miller, P.D.; Schoene, H.; Swenson, J.K.; Vane, C.R.; Schuch, R.; Justiniano, E.; Benhenni, M.; Shafroth, S.M.; Mokler, P.H.; Reusch, S. (Oak Ridge National Lab., TN (USA); Forskningsinstitutet foer Atomfysik, Stockholm (Sweden); East Carolina Univ., Greenville, NC (USA). Dept. of Physics; North Carolina Univ., Chapel Hill (USA). Dept. of Physics; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). 1988. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01. Order Number DE89001576/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

We have studied transfer and simultaneous excitation by three different experimental techniques. Coincidences between two K x rays were measured for S^{15+}, coincidences between one K x ray and the charge exchanged projectile for Li-like F and projectile Auger electrons for H-like F in each case colliding with H_2. For all three collision systems, the measured cross sections are dominated by Resonant Transfer and Excitation (RTE). Also, for the F projectiles, strong contributions from Two Electron Transfer and Excitation (2eTE) were found. 9 refs., 3 figs.

2086 **(DOE/DP/10554—1) Thermal transport studies using extreme ultraviolet spectroscopy: Final technical report, 5 March 1986-30 June 1987.** Griem, H.R. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). Dec 1987. Contract AS08-86DP10554. 59p. NTIS, PC A04/MF A01. Order Number DE89001854/JAW.

Thermal transport was investigated in laser-produced plasmas using spectroscopic measurements in the extreme ultraviolet. Theoretical work in collaboration with the University of Rochester allowed comparisons to be made of experimental spectra to a lagrangian hydrodynamic code. Results showed that transport is influenced by thermal flux inhibition in addition to non-uniformities in the laser irradiation. This work is a continuation of last year's project in which the main thermal transport results are reported. Very rich spectra were obtained in these experiments which yielded additional information on the ablating plasmas. A doppler shift was observed for neonlike titanium lines relative to higher ionization states of Ti. This shift is attributed to differences in expansion velocities between different charge states of Ti. A detailed report discussing this effect is attached. New lines were identified for Ti XXI and Ti XIX from these spectra in the wavelength region from 12 to 15 {angstrom}. The new heliumlike lines of Ti can exhibit population inversion and are candidates for x-ray laser experiments. A preprint of this paper is attached. Finally, line ratios of Ti XIX and Ti XX were employed to determine electron densities and temperatures. A report is also attached discussing these results.

2087 (INIS-mf—11319, pp 49) **K-shell x-ray spectra of Cu and Zn by N-ion bombardment.** Kotze, P.B.; Van Waart, H. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2088 (INIS-mf—11319, pp 48) **Search for resonances in the e/sup +/ -e/sup -/ two-photon decay channel.** Connel, S.W.; Fearick, R.W.; Hoernle, R.F.A.; Shrivastava, E.; Sideras-Haddad, E.; Sellschop, J.P.F. (University of the Witwatersrand, Johannesburg (South Africa)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2089 (INIS-SU—68, pp 103) **Experimental study of nucleus excitation in muon decay at the K orbit of /sup 152/Sm mesic atom.** Sabirov, B.M.; Abazov, V.M.; Voinova-Eliseeva, N.A. and others. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2090 (IPPJ—859, pp 250-255) **Generation of high brightness ion beam from insulated anode PED.** Matsukawa, Yoshinobu. (Osaka City Univ. (Japan). Research Inst. for Atomic Energy). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

Generation and focusing of a high density ion beam with high brightness from a organic center part of anode of a PED was reported previously. Mass, charge and energy distribution of this beam were analyzed. Three kind of anode were tried. Many highly ionized medium mass ions (up to C/sup 4+/, O/sup 6+/) accelarated to several times of voltage difference between anode and cathode were observed. In the case of all insulator anode the current carried by the medium mass ions is about half of that carried by protons.

2091 (IPPJ—859, pp 330-341) **High pressure operation of beam diodes for generating relativistic electron beams.** Matsuzawa, Hidenori; Akitsu, Tetsuya. (Yamanashi Univ., Kofu (Japan). Faculty of Engineering). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

A beam diode was operated successfully at a pressure as high as 10/sup -1/ {similar←to} 10/sup -2/ Torr of gases (He, H/sub 2/, Ne, N/sub 2/, CO/sub 2/, and SF/sub 6/). Each gas had its optimum pressure p/sub m/ at which electron beam currents were higher in peak values than those for conventional in-vacuum operation by a factor of 1.5 or more. A relationship p/sub m/ x σ/sub H//sup 1.18/ = const. was obtained where σ/sub H/ is the total ionization cross sections in gases at some hundred keV. A model was proposed for such operations, and those high pressure operations are preferable to the conventional if one needs higher currents.

2092 **(JINR-R—4-87-901) Atom de-excitation in unexcited medium.** Shirokov, M.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704643/JAW.

Submitted to the journal Theor. Math. Phys. .

It is shown that the presence of an unexcited atom A does not practically change the time law of the de-excitation of an excited atom D (the distance R between A and D is supposed to be much larger than the wavelength of D radiation). The analysis of the derivation of this qualitative result shows that it is a consequence not of the QED details but of two general properties of the free electromagnetic field operators: the local commutativity and standard particle (photon) interpretation of the field. A method of calculating the inclusive probability is suggested which uses the picture intermediate between the Heisenberg and interaction pictures. It turns out to be simpler than the standard calculation in the interaction picture. 15 refs.; 2 figs.

2093 **(LA-UR—88-771) Supercomputers and atomic physics data.** Abdallah, J. Jr.; Clark, R.E.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-881112—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007903/JAW.

From Supercomputing conference; Orlando, FL, USA (14 Nov 1988).

The advent of the supercomputer has dramatically increased the possibilities for generating and using massive amounts of detailed fine structure atomic physics data. Size, speed, and software have made calculations which were impossible just a few years ago into a reality. Further technological advances make future possibilities seem endless. The cornerstone atomic structure codes of R.D. Cowan have been adapted into a single code CATS for use on Los Alamos supercomputers. We provide a brief overview of the problem; and report a sample CATS calculation using configuration interaction to calculate collision and oscillator strengths for over 300,000 transitions in neutral nitrogen. We also discuss future supercomputer needs. 2 refs.

2094 **(N—88-24252) Total photoionization cross sections of atomic oxygen from threshold to 44.3A.** Angel, G.C.; Samson, J.A.R. (Nebraska Univ., Lincoln (USA)). 1987. 31p. (NASA-CR—182992; NAS—1.26:182992). NTIS, PC A03/MF A01.

The relative cross section of atomic oxygen for the production of singly charged ions has been remeasured in more detail and extended to cover the wavelength range 44.3 to 910.5 A by the use of synchrotron radiation. In addition, the contribution of multiple ionization to the cross sections has been measured allowing total photoionization cross sections to be obtained below 250 A. The results have been made absolute by normalization to previously measured data. The use of synchrotron radiation has enabled measurements of the continuum cross section to be made between the numerous autoionizing resonances that occur near the ionization thresholds. This in turn has allowed a more critical comparison of the various theoretical estimates of the cross section to be made. The series of autoionizing resonances leading to the 4-P state of the oxygen ion have been observed for the first time in an ionization type experiment and their positions compared with both theory and previous photographic recordings.

2095 **(N—88-24541) Gamma 1 and gamma 3 bands of (16)O_3: Line positions and intensities.** Flaud, J.M.; Camy-Peyret, C.; Devi, V.M.; Rinsland, C.P.; Smith, M.A.H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1988. 23p. (NASA-TM—101162; NAS—1.15:101162). NTIS, PC A03/MF A01.

Using 0.005/cm-resolution Fourier transform spectra of samples of ozone, the gamma 1 and gamma 3 bands of (16)O_3 have been reanalyzed to obtain accurate line positions and an extended set of upper state rotational levels (J up to 69, K sub a up to 20). Combined with the available microwave data, these upper state rotational levels were satisfactorily fitted using a Hamiltonian which takes explicitly into account the strong Coriolis interaction affecting the rotational levels of these two interacting states. In addition, 350 relative line intensities were measured from which the rotational expansions of the transition moment operators for the gamma 1 and gamma 3 states have been deduced. Finally, a complete listing of line positions, intensities, and lower state energies of the gamma 1 and gamma 3 bands of (16)O_3 has been generated.

2096 **(N—88-24542) Line positions and intensities for the gamma 1 + gamma 2 and gamma 2 + gamma 3 bands of (16)O_3.** Devi, V.M.; Flaud, J.M.; Canypeyret, C.; Rinsland, C.P.; Smith, M.A.H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1988. 22p. (NASA-TM—101161; NAS—1.15:101161). NTIS, PC A03/MF A01.

Using 0.005 cm-resolution Fourier transform spectra of (16)O_3, generated by electric discharge from a greater than 99.98 percent pure sample of (16)O_3, an extensive analysis of the gamma 1 + gamma 2 and the gamma 2 + gamma 3 bands in the 5.7 micron region was performed. The rotational energy levels of the upper (110) and (011) vibrational states of (16)O_3 were reproduced within their experimental uncertainties using a Hamiltonian which takes explicitly into account the Coriolis-type interaction occurring between the rotational energy levels of both states. Improved vibrational energies and rotational and coupling constants were also derived for the (110) and (011) states. Precise transition moment constants for these two bands were deduced from analysis of 220 measured line intensities. Finally, a complete list of line positions, intensities, and lower state energies for both bands has been generated.

2097 **(SAND—88-2680C) Laser production of ion channels.** Riley, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-8809149—19). NTIS, PC A02/MF A01. Order Number DE89001507/JAW.

From DARPA/SDIO services annual propagation review; Newport, RI, USA (12 Sep 1988).

Several laser ionization schemes appear practical for the production of channels of ionization in the high atmosphere where the dominant atomic/molecular species is atomic oxygen. These ion channels are to act as guides for the propagation of electron beams. Our exploration of the laser ionization process can be divided into two classes: first, true multiphoton schemes which use excimer lasers to produce a two-photon transition from the O ground ^3P level to the first excited ^3P level, and, second, ladder schemes which use 130nm radiation to directly excite the ^3S level. Results obtained from computer simulations of these schemes will be discussed. 7 refs., 1 fig.

2098 **(UCID—21526) Documentation of work developing theoretical methods for treating atomic excitation in a cavity: Progress report.** Shaw, M.J.; Shore, B.W.; Johnson, M.A. (Lawrence Livermore National Lab., CA (USA)). 10 Oct 1988. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01. Order Number DE89001855/JAW.

This memo documents a portion of our work developing methods to treat selective excitation (and subsequent ionization) of atomic vapor in a cavity. Specifically, it describes a technique for solving the coupled Maxwell-Bloch equations for atoms in a one-dimensional cavity by means of a spatial quasi-Fourier expansion that introduces a sequence of increasing spatial harmonics for atomic populations and coherences. We present this method and the algorithm that forms the basis of a computer code for solving these equations. We present examples of solutions for a simple model of stationary two-state atoms in the limit of very low density. These examples illustrate both the usefulness and the limitations of spatial quasi-Fourier expansion techniques. In particular, the examples presented here show the importance of retaining a succession of spatial harmonics when the excitation is coherent (as evidenced by Rabi oscillations). 12 refs., 5 figs.

2099 **(UCID—21529) BBFT [Boltzmann-Bloch Finite-Temperature]: A finite-temperature Monte Carlo for Coulomb systems.** Theilhaber, K.; Pollock, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1988. Contract W-7405-ENG-48. 38p. NTIS, PC A03/MF A01. Order Number DE89001902/JAW.

We describe the computer program "BBFT," a finite-temperature, quantum Monte-Carlo code for a three-dimensional electron-proton system. This code uses a path-integral approach to obtain the equilibrium properties of the system, including the energy, pressure and radial distribution functions. Detailed descriptions of the Monte-Carlo algorithm, and of the approximations used in accounting for particle interaction are given. The results of simple test of the code are also presented. A fundamental limitation of the code is that it models the particles as distinguishable, and hence ignores Fermi statistics. 17 refs.

2100 **(UCRL—99666) Sensitivity analysis of time-dependent non-LTE kinetics.** Scott, H.A. (Lawrence Livermore National Lab., CA (USA)). 1 Oct 1988. Contract W-7405-ENG-48. 9p. (CONF-881093—5). NTIS, PC A02/MF A01. Order Number DE89001499/JAW.

From Nuclear explosives code developer's conference; Boulder, CO, USA (11 Oct 1988).

Many computational problems of current interest involve the use of large, detailed atomic models in time-dependent non-LTE

situations. The atomic models, which can include more than a hundred atomic levels and several thousand transition rates and cross sections, are computationally very expensive but are necessary for accurately modeling the physical problem. The sheer size of the models, however, makes it very difficult to analyze their performance and extract information about physical processes. Sensitivity analysis provides an efficient tool for performing these analyses. The computer code XRSENSE has been developed to apply sensitivity theory to simulations run with XRASER. We describe the formalism used and demonstrate some of the possibilities of this approach. 1 ref., 4 figs.

2101 **(UCRL—99699) X-ray spectroscopy of highly-ionized atoms in an electron beam ion trap (EBIT).** Marrs, R.E.; Bennett, C.; Chen, M.H.; Cowan, T.; Dietrich, D.; Henderson, J.R.; Knapp, D.A.; Levine, M.A.; Schneider, M.B.; Scofield, J.H. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 14p. (CONF-8808147—1). NTIS, PC A03/MF A01. Order Number DE89001718/JAW.

From International conference on the physics of multiply charged ions; Grenoble, France (14 Aug 1988).

An Electron Beam Ion Trap at Lawrence Livermore National Laboratory is being used to produce and trap very-highly-charged-ions (q {le} 70+) for x-ray spectroscopy measurements. Recent measurements of dielectronic recombination, electron impact excitation and transition energies are presented. 15 refs., 12 figs., 1 tab.

2102 **Computer modeling of negative ion beam formation.** Whealton, J.H.; Bell, M.A.; Raridon, R.J.; Rothe, K.E.; Ryan, P.M. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **64**: No. 11, 6210-6226(1 Dec 1988).

Sources of root-mean-square (RMS) emittance growth are described for negative ion extractors in both volume and surface negative ion sources and plasma low-energy beam transport systems. For surface negative ion sources of the Lawrence Berkeley Laboratory or Los Alamos National Laboratory [on Los Alamos Meson Particle Facility (LAMPF)], attention is paid to the nonlinear transverse emittance growth mechanism of the beam/warm plasma interaction. In some cases this is a large effect. In addition, non-normal sheath fields at a convertor are examined as a source of emittance growth. For volume sources, attention is paid to aberration production due to field penetration from the extractor, RMS emittance growth enhancement by a negatively biased plasma extraction electrode, and emittance growth caused by transverse extraction across a magnetic field. For both volume and surface sources, RMS emittance growth due to nonlinear aberration at the plasma extraction electrode is analyzed. Time-dependent contributions to emittance growth are also examined. Nonlinear saturation of ion acoustic waves caused by ion extraction from a warm plasma and beam transversal through a plasma are studied.

2103 **Resonance ionization spectroscopy of a new 1 ^1m/sub u/left-arrowA ^{1}Pi/sub u/ band system of C_2.** Goodwin, P.M.; Cool, T.A. (School of Applied and Engineering Physics, Cornell University, Ithaca, New York 14853). *Journal of Chemical Physics;* **89**: No. 11, 6600-6611(1 Dec 1988).

Thirteen vibronic bands assigned to the two-photon 1 $^1\Delta$/sub u/left-arrowA ^{1}Pi/sub u/ transition, ν_{00} = 49 097 +- 1 cm^{-1}, have been observed by (2+2) resonance-enhanced multiphoton (REMPI) spectroscopy for laser wavelengths ranging from 370—480 nm. The measured term value T/sub e/ = 57 720 +- 2 cm^{-1} of the previously unobserved 1 $^1\Delta$/sub u/ state is in good agreement with upper limits given by ab initio calculations. Additional spectroscopic constants measured for the 1 $^1\Delta$/sub u/ state are: D_0 = 12 990 cm^{-1}, ω/sub e/ = 1150 +- 1 cm^{-1}, ω/sub e/x/sub e/ = 21.3 +- 0.5 cm^{-1}, B/sub e/ = 1.361 +- 0.002 cm^{-1}, α/sub e/ = 0.026 +- 0.002 cm^{-1}, and r/sub e/ = 1.437 +- 0.002 A.

2104 **Parametric potential method for generating atomic data.** Rogers, F.J.; Wilson, B.G.; Iglesias, C.A. (Lawrence Livermore National Laboratory, University of California, P.O. Box 808, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 10, 5007-5020(15 Nov 1988).

It is shown that an analytic effective potential given by a sum of Yukawa terms plus a long-ranged Coulomb tail can provide atomic data (energy levels, oscillator strengths, photoionization cross sections) of accuracy comparable to single-configuration, relativistic, self-consistent-field calculations. The Yukawa terms are weighted by shell occupancy. The screening parameters in the exponentials account for electron shielding of the nuclear charge. Parameter values are obtained by an iterative solution for the eigenvalues of a spin-averaged Dirac equation to match experimental ground-state configuration-averaged ionization energies. The configuration term structure is included by use of Condon-Slater theory. Scaling laws to adjust the screening parameters are given in order to account for multiply excited configurations, inner-core excitations, and the orbital-angular-momentum dependence of excited valence electrons. The method is used to generate prefitted effective potentials for all isoelectronic sequences up to zinc. Comparisons to experimental and self-consistent-field calculations are presented.

2105 **Radiative lifetimes of Am I atomic levels.** Arndt, T.; Backe, H.; Steinhof, A.; Dyer, P.; Fowler, M.M.; Eller, P.G.; Wilhelmy, J.B. (Institut fuer Physik der Universitaet Mainz, Postfach 3980, D-6500 Mainz, Federal Republic of Germany). *Physical Review [Section] A: General Physics;* **38**: No. 10, 5084-5091(15 Nov 1988).

The lifetimes of several atomic levels of Am I that are connected by electric dipole transitions to the ground state have been measured. The Am atoms were excited by light pulses from a cw single-mode dye laser with the aid of an optoacoustic modulator. The decay curve of the delayed emitted photons was measured by counting single photons in the beam-off periods. The lifetimes of 14 levels in the wavelength region between 6405 and 4265 A were measured using Am-metal vapor. The metallic Am was obtained by reducing AmO_2 with La at 1500 °C in a high-vacuum system and collecting Am on a catcher foil. The Am vapor was then produced by controlled reevaporation from the foil at a temperature of about 800 °C. These lifetime measurements, in combination with the line intensities from a hollow-cathode discharge, allow the identification of the Am transitions homologous to the strong Eu I transitions from the y^{8}P/sub 5/2,7/2,9/2/ terms to the ground state.

2106 **Lifetime of the 2^1S_0 state of heliumlike Ni/sup 26+/.** Dunford, R.W.; Berry, H.G.; Groeneveld, K.O.; Hass, M.; Bakke, E.; Raphaelian, M.L.A.; Livingston, A.E.; Curtis, L.J. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] A: General Physics;* **38**: No. 10, 5423-5425(15 Nov 1988).

We report the observation of the two-photon decay of the 2^1S_0 level in heliumlike Ni/sup 26+/ and a measurement of the lifetime of this state. We find a lifetime of 150(16) ps, in agreement with the theoretical calculation of G. W. F. Drake [Phys. Rev. A 34, 2871 (1986)] which yields 154.3(5) ps.

2107 **Boundary-corrected Born approximation for muon capture from the K shell of $\alpha\mu$.** Saini, S.; Kulander, K.C. (Theoretical Atomic and Molecular Physics Group, Lawrence Livermore National Laboratory, University of California, P.O. Box 808, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 10, 5045-5052(15 Nov 1988).

The first Born approximation with boundary conditions which take the asymptotic Coulomb phases into full account is used to calculate the muon charge-transfer cross sections from $\alpha\mu$ to protons at intermediate and high collision energies. Our computed cross sections are in good agreement with the experimental data on the equivalent electronic system in the energy range 50 to 180 keV.

2108 **Absolute excited state and ion densities from two- and three-photon processes in some 6p levels of atomic krypton.** Khambatta, N.M.; Oertel, J.A.; Silk, R.; Radziemski, L.J.; Mack, J.M. (New Mexico State University, Applied Laser/Optics Group, Department of Physics, Las Cruces, New Mexico 88003). *Journal of Applied Physics;* **64**: No. 10, 4809-4814(15 Nov 1988).

Neutral krypton atoms are excited from the ground state to the $4p^5 6p[3/2]_2$ state by two-photon absorption from an ArF excimer laser operating at 193.41 nm. The third photon ionizes the krypton atoms. Excitation and ionization yields are theoretically computed employing the standard laser rate-equations analysis. Measurements are made on both the excitation and ionization yields. The experimental results are in good agreement with the theoretical predictions of our formulations, as well as with those of other authors.

2109 **Resonant transfer and excitation in Li-like F colliding with H_2.** Schulz, M.; Schuch, R.; Datz, S.; Justiniano, E.L.B.; Miller, P.D.; Schoene, H. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6377). *Physical Review [Section] A: General Physics;* **38**: No. 10, 5454-5457(15 Nov 1988).

We have measured conicidences between x rays and projectiles that have captured one electron in F/sup 6+/+H_2 collisions at projectile energies between 15 and 33 MeV. The cross sections for capture and simultaneous x-ray emission as a function of projectile energy show clear structures. Indications of an unexpectedly high population of high-n states predominantly formed by resonant transfer and excitation (RTE) was found. Above the KLn ($n>1$) RTE resonance energies another maximum was observed.

2110 **Fine structure and analytical quantum-defect wave functions.** Kostelecky-acute-accent, V.A.; Nieto, M.M.; Truax, D.R. (Department of Physics, Indiana University, Bloomington, Indiana 47405). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4413-4418(1 Nov 1988).

We investigate the domain of validity of previously proposed analytical wave functions for atomic quantum-defect theory. This is done by considering the fine-structure splitting of alkali-metal and singly ionized alkaline-earth atoms. The Lande formula is found to be naturally incorporated. A supersymmetric-type integer is necessary for finite results. Calculated splittings correctly reproduce the principal features of experimental values for alkali-like atoms.

2111 **Studies of Rydberg-valence mixed autoionizing states in NO.** Lynch, D.L.; Schneider, B.I.; Collins, L.A. (Los Alamos National Laboratory Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4927-4930(1 Nov 1988).

Interference between overlapping Rydberg- and valence-level autoionizing states can have dramatic effects on photoionizing dynamics. Our calculations demonstrate this type of interference in NO, where we predict that the autoionizing structure is of a mixed Rydberg-valence character and dominates the cross sections, obscuring the underlying shape resonance. Such studies have important implications for understanding autoionization mechanisms in molecular systems as well as other areas of physics.

2112 **Near-threshold photoabsorption cross sections for nonhydrogenic ions.** Wilson, B.G.; Iglesias, C.; Rogers, F. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4633-4638(1 Nov 1988).

Nonhydrogenic photoabsorption cross sections near threshold are well approximated by radial dipole-matrix elements between phase-shift-modulated regular and irregular Coulomb continuum and quantum-defect bound-state wave functions. Results based upon numerical quadratures are inaccurate for high-Rydberg transitions, while previous analytical formulas are difficult to evaluate near threshold. A simple analytic algorithm for the near-threshold region based on the analytic properties of the Coulomb functions in the complex energy plane is presented.

2113 **Measurement of ionization and recombination rates for FeXVI—Fe XXII from time-resolved spectroscopy of tokamak plasmas.** Wang, J.; Griem, H.R.; Hess, R.; Rowan, W.L. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4761-4765(1 Nov 1988).

The effective ionization and recombination rate coefficients for FeXVI—Fe XXII were obtained by studying the modulation of line emissions by sawtooth oscillations in the TEXT tokamak. Experimental data are matched with the simulation of iron ion emission by a one-dimensional code. The rate coefficients were determined for T/sub e/~350—900 eV and N/sub e/~(4—5.6) x 10/sup 13/ cm/sup -3/. The rate coefficients for Fe XVI, XVII, and XVIII have large uncertainty partly due to uncertainty of the temperature profile at large radii of the plasma and partly due to other possible atomic processes. The error of ionization rates for Fe XIX—Fe XXII is estimated to be less than 40%, while the estimated accuracy of the recombination rates is better than a factor of 2.

2114 **V/2 electron emission in ion-atom collisions with short-range potentials.** Burgdoerfer, J.; Wang, J.; Barany, A. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996-1200). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4919-4922(1 Nov 1988).

Exact differential ionization probabilities have been calculated for inelastic ion-atom collisions in one dimension with interaction potentials of zero range. The ionization spectrum confirms the existence of the so-called v/2 electrons; i.e., a hump in the spectrum at a velocity close to half of the velocity of the projectile at intermediate collision energies while the customary electron-capture-to-continuum (ECC) and electron-loss-to-continuum (ELC) peaks are missing. The enhancement near v/2 disappears at high energies with the binary-encounter peak being the predominant feature, while shoulder structures develop near the target and projectile velocities which resemble but do not coincide with ECC and ELC peaks.

2115 **Desorption yield for valine as induced by fast heavy ions.** Beining, P.; Scheer, J.; Nieschler, E.; Nees, B.; Voit, H. (Fachbereich 1 (Physik/Elektrotechnik), Universitaet Bremen, D-2800 Bremen, Federal Republic of Germany). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8640-8644(1 Nov 1988).

The dependence of the desorption yield for the amino acid valine on the energy of different MeV primary ions has been measured. The primary-ion energies cover a relatively large range with corresponding energy losses between 2 and 55 keV/(μg/cm^2). The observed energy dependence can be understood in the framework of a simple macroscopic model.

2116 **Factors determining dissociation fractions in atomic beams generated by "straight-through" microwave discharge sources.** Spence, D.; Steingraber, O.J. (Argonne National Laboratory, Argonne, Illinois 60439). *Review of Scientific Instruments;* **59**: No. 11, 2464-2467(Nov 1988).

We have studied the parameters affecting the degree of dissociation in atomic beams produced by a source consisting of a quartz tube with an exit slit downstream from a microwave discharge, which is maintained by means of an Evenson cavity. These parameters include the effects of catalysts, discharge tube diameter, slit width, cavity-slit distance, discharge power, and tube material in producing atomic beams of hydrogen, oxygen, nitrogen, and the halogens. The achievable degree of dissociation is found to be quite sensitive to all those parameters except discharge power and tube material. Optimal values are presented.

2117 **Electron impact ionization of U/sup 88+/—U/sup 91+/.** Claytor, N.; Feinberg, B.; Gould, H.; Bemis C.E. Jr.; Gomez del Campo, J.; Ludemann, C.A.; Vane, C.R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 18, 2081-2084(31 Oct 1988).

We channeled 405-MeV/nucleon uranium ions in Si single crystals to determine the electron impact ionization cross section for berylliumlike-hydrogenlike uranium by 222-keV electrons. Our cross sections are 3.9 11.0, 16.0, and 31.0 b (+100%, -50%), respectively, for ionizing 1s, $1s^2$, 2s, and $2s^2$ electrons. Our 1s and $1s^2$ results disagree with present theory. Our 2s and $2s^2$ results are not accurate enough to distinguish between theories.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 2571

2118 **(AD-A—195643/2/XAB) Experimental study of a parallel-plate radio-frequency discharge: measurements of the radiation temperature and electron density.** Hebner, G.A.; Verdeyen, J.T.; Kushner, M.J. (Illinois Univ., Urbana (USA). Gaseous Electronics Lab.). 1 Apr 1988. 12p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 63, No. 7, 2226-2236(1 Apr 1986).

Microwave diagnostic techniques have been used to measure the radiation temperature and electron density in parallel-plate capacitively coupled radio-frequency (2.5 MHz) discharges. Evidence is presented for the existence and importance of an energetic electron beam, produced by the large cathode sheath voltage, which sustains and excites the plasma. The measured radiation temperature of the bulk electrons is 500 K for helium and 800 K for argon. An upper limit on the radiation temperature is obtained for N_2 (1200 K) and CF_4 (3000 K) discharges. Measurements of the electron density in helium as a function of electrode spacing show a peak in the electron density that is consistent with the theory of ionization by beam electrons. The electric fields required to carry the rf current by drift in the bulk of the glow are low and consistent with the measured radiation temperature. The implications of these measurements on the nature of the rf plasma-sustaining mechanism. The voltage distribution, and the electron energy distribution are discussed.

2119 **(AD-A—196591/2/XAB) Laser-sustained plasma in forced argon convective flow. Part 1. Experimental studies.** Welle, R.; Keefer, D.; Peters, C. (Tennessee Univ., Tullahoma (USA). Space Inst.). Aug 1987. 9p. NTIS, PC A02/MF A01.

Pub. in AIAA (American Institute of Aeronautics and Astronautics) Jnl., Vol. 25, No. 6, 1093-1099(Aug 1987).

The results of an experimental investigation of the properties of laser-sustained plasmas in argon at forced convective flow speeds of 0.4-4.5 m/s are reported in this paper. At these speeds, the incident flow rate has a significant effect on the shape, size and position of the plasma, which in turn affect the power absorption, thermal radiation, and total energy conversion efficiency of the plasma. In addition to the incident flow rate, the focusing geometry, chamber pressure, and laser power were varied as parameters in the experiments. The thermal conversion efficiency was found to range 9-38%, depending on the various parameters.

2120 **(ANL—87-47) Some issues concerning fluidelastic instability of a group of circular cylinders in crossflow.** Chen, S.S. (Argonne National Lab., IL (USA)). Apr 1988. Contract W-31109-ENG-38. 36p. (CONF-881119—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88010068/JAW.

From Symposium on flow induced vibration and noise; Chicago, IL, USA (28 Nov 1988).

Since the early 1970s, extensive studies of fluidelastic instability of circular cylinders in crossflow have been reported. A significant understanding of the phenomena involved now exists. However, some confusion, misunderstanding, and misinterpretation still remain. The objective of this report is to discuss, on the basis of the current state of the art, a series of the most asked questions. Emphasis is placed on the determination of the critical flow velocity, nondimensional parameters, stability criteria, and instability mechanisms. 23 refs., 4 figs., 3 tabs.

2121 **(CONF-8807123—1) Bubble growth in superheated He-II.** Dresner, L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01. Order Number DE89001874/JAW.

From Space cryogenics workshop; Frascati, Italy (18 Jul 1988).

Bubble growth in superheated He-II is controlled by the transfer of heat to the surface of the growing bubble by nonlinear Gorter-Mellink counterflow. The present work presents analytic formulas for the bubble radius as a function of time in the limiting cases of small and large superheats. The formulas include the effect of the inertial reaction of the surrounding liquid to the expansion of the bubble. A numerical example shows that bubble velocities of the order of meters per second are possible. A related problem, involving only heat transfer but no movement of the liquid, is the motion of the free surface of superheated He-II in a very long tube. This problem has a similarity solution. The interfacial velocity in the tube is much smaller than the bubble growth velocity. 1 ref.

2122 **(DOE/ER/02504—469) High Energy Accelerator and Colliding Beam User Group: Progress report, March 1, 1988--February 28, 1989.** (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Sep 1988. Contract AC05-76ER02504. 145p. NTIS, PC A07/MF A01. Order Number DE89002011/JAW.

This report discusses work carried out by the High Energy Accelerator and Colliding Beam User Group at the University of Maryland. Particular topics discussed are: OPAL experiment at LEP; deep inelastic muon interactions; B physics with the CLEO detector at CESR; further results from JADE; and search for "small" violation of the Pauli principle. (LSP)

2123 **(DOE/ER/13837—T1) Comparative study of vorticity field in turbulent flows: Report on activities, December 15, 1987--December 14, 1988.** Levich, E. (City Coll., New York (USA)). 1988. Contract FG02-88ER13837. 9p. NTIS, PC A02/MF A01. Order Number DE89001804/JAW.

The main efforts of this project were to develop tools in studying turbulent flow. The theoretical tool is the model which allow to reduce 3-D nonequilibrium stationary driven turbulence to a 4-D equilibrium system. The numerical tool is the efficient and reliable 3-D Navier--Stokes code with control of helicity spectrum. The experimental tool is 9-hot-wire probe of a new type and software for data acquisition. Along with the development of these tools we obtained new physical results. In this report we are giving a short description of the work completed.

2124 **(LA—11342-C) Proceedings of the conference on numerical methods in high temperature physics.** Alcouffe, R.E.; Holm, D.D.; O'Rourke, P.J. (comps.). (Los Alamos National Lab., NM (USA)). Nov 1988. Contract W-7405-ENG-36. 342p. (CONF-8702100—). NTIS, PC A15. Order Number DE89001761/JAW.

From Congress on numerical analysis; Los Alamos, NM, USA (2 Feb 1987).

These proceedings contain full papers presented at the Los Alamos Conference on High Temperature Physics. This conference discussed many aspects of high temperature physics including hydrodynamics, radiation and particle transport and some computational issues important for efficient calculations. The meetings was held between researchers from Los Alamos and the French Commissariat a L'Energy Atomique (CEA).

2125 **(N—88-25239) Solving time-dependent two-dimensional eddy current problems.** Lee, M.E.; Hariharan, S.I.; Ida, N. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1988. 32p. (NASA-TM—100875; E—4106; NAS—1.15:100875). NTIS, PC A03/MF A01.

Results of transient eddy current calculations are reported. For simplicity, a two-dimensional transverse magnetic field which is incident on an infinitely long conductor is considered. The conductor is assumed to be a good but not perfect conductor. The resulting problem is an interface initial boundary value problem with the boundary of the conductor being the interface. A finite difference method is used to march the solution explicitly in time. The method is shown. Treatment of appropriate radiation conditions is given special consideration. Results are validated with approximate analytic solutions. Two stringent test cases of high and low frequency incident waves are considered to validate the results.

2126 **(NRL-MR—6240) Investigation of collisional effects in the plasma erosion opening switch.** Grossmann, J.M.; Neri, J.M.; Ottinger, P.F.; Kulsrud, R. (Naval Research Lab., Washington, DC (USA); JAYCOR, Vienna, VA (USA)). 20 Sep 1988. Contract AI03-79DP40092. 41p. NTIS, PC A03/MF A01. Order Number DE89001396/JAW.

During the conduction phase of the plasma erosion opening switch (PEOS), current channels in the main body of the plasma have been observed experimentally to be much wider than the collisionless skin depth. In addition, the maximum current carried by the switch before opening (the conduction current) seems to scale roughly linearly with plasma density, n, and switch length, l. Collisionless PIC code simulations of the plasma switch show current conducted in skin-depth like channels, with the conduction current scaling close to l[275] and n/sup 1/4/. Here the effect of collisions on the behavior of the PEOS is investigated and shown to bring the PIC simulations and experimental results in closer agreement. In the collisional simulations, wider current channels are observed and the conduction current scales linearly with l and as n/sup 1/2/ with density in anode dominated simulations. Linear scaling with length and density in the cathode dominated case can be inferred. 38 refs., 7 figs., 2 tabs.

2127 **(PB—88-235395/XAB) Direct action of electromagnetic fields on fluids. Final report. Report on phase 2.** Philp, S.F. (Eagle Engineering, Inc., Pittsfield, MA (USA)). 27 Nov 1985. 44p. NTIS, PC A03/MF A01.

See also PB—84-222298.

Fluids with imbedded charges or currents can interact with electric and magnetic fields. The aspect of magnetofluid dynamics has been explored with particular reference to its possible application in pumping fluids and in the measurement of fluid flow. A charge-injection/electric-field pump has the advantage that electric power is converted directly into fluid power, in a simple device, with no moving parts; the main disadvantage is that the technique is limited to very low pressures (10,000 Pascal, or less). The study of magnetic-fluid interactions led to the development of a device for flow measurement applicable to all fluids, whether insulating or conducting. It is based on the fact that a potential gradient is generated in a fluid that moves in a magnetic field. Such a magnetic transducer can be built very simply and inexpensively, using a permanent magnet as the source of the exciting field. The device covers a wide range of fluid velocities, and is independent of fluid properties and of flow regime.

2128 **(SAND—88-1233C) The modeling of standard gas leaks.** Chamberlin, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 25p. (CONF-881002—16). NTIS, PC A03/MF A01. Order Number DE89001376/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Standard leaks are being increasingly used to provide known quantities of gas for applications, such as determining a mass spectrometer's sensitivity, where it is desirable to know their flow rates for various gas species, and operating temperatures and pressures. Characterizing a leak for such varying conditions presents a challenging task which has been simplified by a model that predicts a leak's throughput for various operational parameters using a limited set of calibration conditions. The model is based on an integrated form of Knudsen's equation for the conductance of a tube in transitional flow. The integration circumvents a restriction of the Knudsen equation violated by the significant pressure drop occurring across a leak. Normalizing the resulting equation provides a model whose independent variable is a function of the operational parameters and whose coefficients depend on the leak's geometry, knowledge of which is not required for the model's use. The resulting model accurately describes a leak's flow rates into both the molecular and viscous regions even though it was developed from a transitional flow base. The model's accuracy is commensurate with the accuracy of the calibration values used in determining its coefficients. 6 refs., 4 figs., 1 tab.

2129 **Nonlinear pattern and wave-number selection in convecting binary mixtures.** Fineberg, J.; Moses, E.; Steinberg, V. (Department of Nuclear Physics, Weizmann Institute of Science, Rehovot, 76100, Israel). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4939-4942(1 Nov 1988).

We investigate the transition from weakly nonlinear to nonlinear traveling-wave states. Pattern selection due to a transition from convective to absolute instability conditions is found, in good agreement with theory. While the linear properties depend on the (boundary-dependent) threshold of convection, the weakly nonlinear properties refer back to the threshold of an infinite system.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 2247

2130 **(DOE/ER/40318—2) High energy physics at the University of Iowa: Progress report, 1 February 1987-31 January 1988.** McCliment, E.R.; Newsom, C.R.; Onel, Y.; Mallik, U. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1988. Contract AC02-87ER40318. 195p. NTIS, PC A09/MF A01. Order Number DE89001865/JAW.

Research in high-energy physics at Iowa is in three areas--hyperon decay (ERM and CRN), hadronic interactions (Y. Onel), and charm physics (U. Mallik). In this document we report our progress in each of these areas. McCliment and Newsom built a silicon Σ^+ and Ξ^- radiative decays. The SSD system was extensively tested in Proton Center during the 1987-1988 fixed-target run. Studies included alignment, tracking, efficiency, noise, and temperature stability. Work was also completed on a measurement of the Ξ^- production polarization and magnetic moment from E715 data. A draft of the paper is included in the progress report as Appendix A. The polarized beam line for experiment E704 was commissioned during the same fixed-target run. Onel and his students were involved in running and developing the analysis for the Coulomb Nuclear Interaction Polarimeter. Our preliminary analysis indicates that the polarization beam is consistent with design expectations. During 1988 we also constructed five drift chambers and a delay line chamber for Fermilab experiment E683. We have also spent a limited amount of time on our CERN activities in designing, planning, and doing calculations and simulations for M258 (SPINSPLITTER). At MARK III, U. Mallik completed an amplitude analysis of the decay mode $J/\{Psi\} \rightarrow \Omega + f_2$ (1270), which will soon be submitted to Physical Review D. A draft of this paper is included as Appendix B. She presented an invited talk on the MARK III results at the BNL spectroscopy conference, "Glueballs, Hybrids, and Exotics." This talk will be published in the proceedings. She also worked with the e-p physics group at the Snowmass Workshop in Summer, 1988. This work will also be published in the Snowmass proceedings. Her student, Maria Roco, participated in drift chamber repair and software of the MARK III at SLAC in the summer of 1988.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 2237, 2263

2131 **(BNL—41757) The search for proton decay: A look back.** Goldhaber, M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-8806204—5). NTIS, PC A02/MF A01. Order Number DE89001606/JAW.

From 13. international conference on neutrino physics and astrophysics; Boston, MA, USA (5 Jun 1988).

This paper reviews the search for proton decay and discusses future experiments. 1 tab. (LSP)

2132 **(DOE/ER/03130—T20) Neutral strange particle production in neutrino interactions at Tevatron energies.** De, K. (Brown Univ., Providence, RI (USA)). May 1988. Contract AC02-76ER03130. 122p. (COO—3130-TB-266). NTIS, PC A06/MF A01. Order Number DE89001943/JAW.

This thesis reports on a study of neutral strange particle production by high energy muon-neutrinos. The neutrinos were obtained from a 800 GeV proton beam-dump at Fermilab. Neutrino events were observed using a hybrid bubble chamber detector system. The data contained deep inelastic neutrino-nucleon interactions with an average momentum transfer $<Q^2> = 23$ (GeV/c)^2. Rates for K^0 and Λ production in neutrino and anti-neutrino charged current events are presented. The distributions of these particles in Feynman x and rapidity are also studied. Significant differences were observed in the production mechanism for the K^0 meson and the Λ baryon. The production rates of K^0's were observed to increase with energy, whereas the rates for Λ production remained essentially constant. In Feynman x, the K^0's were produced in the central region and the Λ's were produced backwards. The data are compared with the LUND monte carlo for string fragmentation. In the monte carlo, K^0's are mostly produced from s{bar s} pair production during fragmentation. The Λ's are generally produced through recombination with the diquark from the target nucleon. The data agree with this model for strange particle production. 39 refs., 24 figs., 10 tabs.

2133 **(DOE/ER/40315—145) Perspective in strange particle physics.** Barnes, P.D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics). 1987. Contract FG02-87ER40315. 26p. (CONF-8703136—5). NTIS, PC A03/MF A01. Order Number DE89001973/JAW.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

The strangeness degree freedom has been studied extensively in nuclear and particle physics and has provided new insight into both strong and weak interactions. Nuclear related topics will be concentrated on. The prospects for new information on the strong hyperon-nucleon interaction from new hypernuclear spectroscopy measurements are discussed. The weak hyperon-nucleon interaction, observed in hypernuclear decay, is discussed as well as strange dibaryon physics. 32 refs., 17 figs., 2 tabs.

2134 **(DOE/ER/40315—148) Hypernuclear weak decay and the $\Delta I = 1/2$ rule.** Barnes, P.D. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics). 1987. Contract FG02-87ER40315. 10p. (CONF-8706212—4). NTIS, PC A02/MF A01. Order Number DE89001975/JAW.

From International symposium on strangeness in hadronic matter; Bad Honnef, F.R. Germany (1 Jun 1987).

Recent measurements of the weak decay of Λ hypernuclei are reported and discussed in the context of the weak hyperon-baryon effective Hamiltonian. The results are compared to predictions of both meson exchange and quark-quark weak interaction models. 14 refs., 4 figs., 2 tabs.

2135 **(DOE/ER/40389—50) Experimental investigations in particle physics at intermediate energies: Performance report, December 1, 1987--November 30, 1988.** Auerbach, L.B.; Highland, V.L.; McFarlane, K.W.; Buchholz, P.; Sivertz, M.B. (Temple Univ., Philadelphia, PA (USA). Dept. of Physics). 21 Sep 1988. Contract FG02-88ER40389. 38p. NTIS, PC A03/MF A01. Order Number DE89002254/JAW.

The major emphasis of this project continues to be on fundamental symmetries and parameters of the Standard Model. The primary project is BNL E791, a search for the decay K/sub L/{degree} $\rightarrow \mu e$, which would violate the rule of separate lepton number conservation. The technique uses a drift-chamber spectrometer, with particle identification, picking out candidate decays from 2-particle triggers by measuring the two-particle invariant mass m, and the colinearity angle Θ/sub c/. For reconstructed K/sub L/{degree} $\rightarrow \pi^+\pi$/sup {minus}/ decays the rms resolution in m was {approximately}1.4 MeV/c^2, and in Θ/sub c/ it was {approximately}0.3 mrad; these values match the design specifications. All the data from the 1988 run of E971 have been analyzed for K/sub L/{degree} $\rightarrow \mu e$, K/sub L/{degree} $\rightarrow \mu\mu$, and K/sub L/{degree} $\rightarrow$ ee events. We find a preliminary upper limit for the branching fraction for K/sub L/{degree} $\rightarrow \mu e$ of 3 {times} 10/sup {minus}10/ and a similar limit for K/sub L/{degree} $\rightarrow$ ee. Our observation of the order of 100 K/sub L/{degree} $\rightarrow \mu\mu$ decays is consistent with previous experiments. The limit on the decay K/sub L/{degree} $\rightarrow \mu e$ which is the best reported by a factor of six, places a lower limit on the mass of a new particle mediating such decays of 50 TeV. The LCD project at LAMPF (measurement of ν {minus} e elastic scattering) has passed several milestones: the physics review of the DOE panel chaired by B. Barish, engineering feasibility studies and financial reviews. 48 refs., 9 figs., 4 tabs.

2136 **(IFVE-OEF—87-86) Meson spectroscopy at Serpukhov accelerator.** Prokoshkin, Yu.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704488/JAW.

Experimental results are reported on the exotic meson spectroscopy (glueballs, meiktons, mutiquark states) obtained at IHEP 70 GeV accelerator. 33 refs.; 25 figs.

2137 **(IFVE-OEF—88-29) Study on the structure of events with increased p/sub t/ in p-barp interactions at 32 GeV/c.** Bogolyubskij, M.Yu.; Bumazhnov, V.A.; Kiryunin, A.E. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704491/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Main features of the so-called trigger particles (the particles with the largest transverse momentum in an event) were studied. Investigations of a hadrons system associated with such a trigger particle were carried out. Distributions of the compensated transverse momentum fluxes were analysed. Experimental data were compared in detail with predictions of two versions of Lund fragmentation model. 10 refs.; 7 figs.; 3 tabs.

2138 **(IFVE-OEF—88-31) Study on meson system structure in events with two leading particles in p-barp interactions at 32 GeV/c.** Chekulaev, S.V.; Bogolyubskij, M.Yu.; Bumazhnov, V.A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 19p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704492/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Meson system properties have been studied using statistics of 13.2 thousand events from p-barp-interactions at 32 GeV/c with n/sub ch/$\geqq$4 involving the leading proton and antiproton. It is shown that with the growth of the effective mass of the pion system its shape in the principle axis frame becomes more elongated and collimation of charged mesons is somewhat higher than in the e/sup +/e/sup -/ annihilation at the same energies. It is found out that the charged mesons from events with two leading particles have harder X/sub R/ spectrum (X/sub R/=2p/M/sub MS/, where p-meson system (MS) momentum in rest system) and smaller multiplicity, than mesons from the e/sup +/e/sup -/ annihilation of the same value of $\sqrt{s}$ which may be caused by the specific kinematic properties of the sample used. 15 refs.; 10 figs.; 2 tabs.

2139 **(IFVE-OEF—88-40) Experimental study of gluon interactions and glueball production in central region of hadron collisions at energies from 500 to 3000 GeV at UNK (accelerating-storage ring).** Prokoshkin, Yu.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 38p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704493/JAW.

The feasibility of an experiment in which glueballs with a mass up to $\sim$ 15 GeV are separated from the background of usual quark states at the highest available energies at UNK (accelerating-storage ring), i.e., up to 3 TeV, is considered. The glueball signal is enhanced both at the production stage (in the central collision

region, X/sub F/ ~ 0) and in the final decay process (into pseudoscalar mesons decaying further into photons, including gg -> P/sub 1/P/sub 2/ -> kγ, 4 ≦ k ≦ 20). The main features of the experimental setup are examined as well as the peculiarities of the detection of multiphoton states with GAMS-type hodoscope spectrometers. The results of test experiments performed at IHEP (40 GeV) and CERN (33 GeV) are presented. 71 refs.; 34 figs.; 2 tabs.

2140 **(IFVE-OEIUNK—87-188) Longitudinal distribution of charged particles produced in 360 GeV/c π/sup -/p interactions on EHS.** Bailly, J.; Verbeure, F.; Vilain, P. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 9p. (In Russian). (CERN-NA—27). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704495/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Results on longitudinal momentum distribution of π+-, K+-, protons and antiprotons produced in 360 GeV/c π/sup -/p interactions are presented. They are compared with other available data and discussed in terms of π/sup -/ fragmentation. 12 refs.; 3 figs.

2141 **(IFVE-OEIUNK—88-13) Multiparticle spectrometer.** Zajtsev, A.M. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704496/JAW.

A program to study on particles with heavy (c and b) quarks at the IHEP accelerating-storage ring hadron and photon beams with the energy up to 3 TeV has been proposed. The setup offered is a wide-aperture two-magnets spectrometer optimized for the experiments in this field. The main trends of the physical program are the defining of Kobayashi-Maskawa matrix elements, lifetime measurements of heavy particles, search for rare decays, study of oscillations in B-B-system, search for CP-violation in heavy meson decays. 17 refs.; 4 figs.

2142 **(IFVE-ONF—88-51) Experimental data processing on π/sup -/-meson dissociation into μ/sup +/μ/sup -/π/sup -/ system on nuclei at Sigma setup.** Bezzubov, V.A.; Eroshin, O.V.; Kartasheva, V.G.; Rojnishvili, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; AN Gruzinskoj SSR, Tbilisi. Inst. Fiziki). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704497/JAW.

An experiment on studying μ/sup +/μ/sup -/π/sup -/- system production in π/sup -/Cu-interactions under 50 GeV/c momentum in π/sup -/+Cu->μ/sup +/+μ/sup -/+π/sup -/... reaction was conducted in 1984-85 at the "Sigma" setup of the IHEP accelerator. General layout and basic algorithms of experimental data processing are considered. 12 refs.; 9 figs.; 1 tab.

2143 **(ITEF—37(1988)) Interference of pions pairs. Detection of positive correlations in (π/sup 0/π/sup +-/) meson systems.** Andryakov, A.D.; Trebukhovskij, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704573/JAW.

Investigations of pion pair interference correlation in four prongs events of π/sup -/p-interaction ar √S ~ 3 GeV are presented. The obtained space-time parameters of the pions generation volume are equal to ctau ~ R ~ 2 fm. This values display no difference within experimental errors between π/sup +/ and π/sup -/-mesons and various channels of the π/sup -/p-interaction. The fact that the transverse space-time parameters of pions generation volume are the same as longitudinal ones allowes to conclude that the shape of emission volume is a sphere. It is proved that resonance production of π-meson does nor affect the pion interference. A positive correlations between neutral and charged pions are found and these correlations cannot be explained by leading π/sup -/-meson effect. 18 refs.; 3 figs.; 4 tabs.

2144 **(JINR-R—1-87-443) Characteristics of fast secondary neutrons in pp and p/sup 12/C interactions at 10 GeV/c.** Bekmirzaev, R.N.; Muminov, N.N.; Suvanov, I.; Grishin, V.G.; Dolejshi, I.; Kladnitskaya, E.N.; Trka, Z. (Samarkandskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704623/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The experimental data have been obtained using the 2 m propane bubble chamber exposed to a beam of 10 GeV/c protons at the synchrophasotron. Average number of secondary fast (P/sub n/ >or approx. 1 GeV/c) neutrons produced in inelastic pp and pC interactions are equal to 0.070 +- 0.14 and 0.89 +- 0.09 respectively. Momentum and angular distributions of fast neutrons with P ≧ 1 GeV/c have been obtained. The charge exchange of a(p -> n) coefficient is practically constant in the energy range from 4 to 300 GeV. The Dubna cascade model calculations are compared with the experimental data. 12 refs.; 2 figs.; 3 tabs.

2145 **(JINR-R—1-87-792) Study on n-barn interactions at 6.1 GeV/c.** Batyunya, B.V.; Boguslavskij, I.V.; Bruntsko, D. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704625/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Inelastic n-barn-interactions at 6.1 GeV/c have been investigated on the basis of ~ 5000 d-bard-events coming from the 2m hydrogen bubble chamber "Ludmila" exposed to separated antideuteron beam with 12.2 GeV/c momentum. The characteristics of the n-barn-interactions have been obtained by studying the d-bard -> p-bar/sub s/ + p/sub s/ + X reaction. The cross sections corresponding to various n-barn-channels, including double charge conjugation, are determined. The general characteristics of the inelastic n-barn-interactions, including one-particle inclusive spectra of π/sup +-/, p and p-bar are presented. The results obtained are also with the isospin symmetry of the n-barn- and p-barp-processes used for cross section estimations of p-barp-annihilation for n/sub ch/ ≦ 6, obtained earlier with the model assumption. 19 refs.; 7 figs.; 5 tabs.

2146 **(LA—11387-T) The measurement of the spin correlation parameters C/sub SL/ and C/sub LL/ in {rvec n}{rvec p} → np scattering at energies 484, 634, and 788 MeV.** Rawool, M.W. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 176p. New Mexico State University, Box 3004, Las Cruces, NM 88003. Order Number TI89001770/JAW.

Thesis. Submitted to New Mexico State Univ., Las Cruces.

Measurements of the spin correlation parameters C/sub SL/ and C/sub LL/ in {rvec n}{rvec p} → np scattering have been made at energies 484, 634, and 788 using a polarized proton target at area BR of the LAMPF accelerator in Los Alamos. The polarized neutron beam was obtained by using the spin transfer reaction d({rvec p},{rvec n})X. The angular range covered by these measurements was between 80{degree} and 180{degree} in the center of mass. Of the outgoing particles only the recoil protons were detected using the 100 msr, magnetic spectrometer. The extracted parameters are in reasonable agreement with the predictions of several phase shift analysis and the Bonn potential. The consistency of this data set with other pp and np data sets at 90{degree} is found to be good. 96 refs., 36 figs., 6 tabs.

2147 **(PNL-SA—16147) Status of selected neutrinoless double-beta decay experiments.** Avignone, F.T.; Brodzinski, R.L.; Reeves, J.H.; Miley, H.S. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1988. Contract AC06-76RL01830. 8p. (CONF-8805142—43). NTIS, PC A02/MF A01. Order Number DE89001726/JAW.

From 3. international conference on the intersections between particle and nuclear physics; Rockport, ME, USA (14 May 1988).

A brief update is given on a number of ongoing 0ν ββ-decay experiments. Progress is reported in background reduction,

limits are given on the various modes of decay, and projections of potential sensitivity are made in some cases. In particular, a new result from the PNL-USC $0\nu\ \beta\beta$-decay experiment yields a half-life of (3.2/sub {minus}1.2//sup +2.2/) {times} 10^{21} y (1σ) for decay with the emission of a majoron. While a positive result is still observed, it is now statistically less significant. A new experiment is in progress utilizing {approximately}200-cm^3 detectors fabricated from recently deep-mined Ge to decrease background cosmogenic radioactivity. 13 refs., 1 tab.

2148 **(RAL—86-002) Compilation of nucleon-nucleon and nucleon-antinucleon elastic scattering data.** Carter, M.K.; Collins, P.D.B.; Whalley, M.R. (Durham Univ., UK. Dept. of Physics). (Rutherford Appleton Lab., Chilton (UK)). Jan 1986. 271p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88780104/JAW.

A compilation of the data on pp, pn, nn, p-barp, p-barn, n-barp, and n-barn is presented, in both tabular and graphical form, including when available the total and elastic cross sections, the differences of the total cross section in different spin states, the ratio of the real to imaginary part of the forward scattering amplitude, the elastic differential cross sections, the polarization asymmetry and the spin correlation parameters, for all laboratory-frame momenta >=2 GeV/c. All the data in this review can be found in and retrieved from the Durham-RAL HEP data base together with data on a wide variety of other reactions.

2149 **(RCNP-P—96, pp 1-6) NNΔ resonance and pd -> /sup 3/He π/sup o/ reaction.** Ueda, T. (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

On the basis of the I = 1, JP = 2+ resonant NΔ interaction (the pp 1D2 dibaryon), one argues that in NNΔ system a three-body resonance is generated. With a clustering binding energy of a few 10 MeV between the N and the Δ making the dibaryon and another binding energy of about 10 MeV between the NΔ cluster and the spectator N due to the attractive interaction of the Δ exchange between the cluster and spectator, the NNΔ system is bound about 40 - 60 MeV below the NNΔ threshold. Because of the Δ decay width the NNΔ bound state is actually a resonant state. The case where the spins of all the particles align in the same direction is most favorable to be bound, since the driving term is largest here. Assigning the zero orbital angular momenta, the spin-parity of the NNΔ resonance is JP = (5/2)+ . The resonance couples with NNN system through NN(1D2)-NΔ(5S2). Thus the total spin of the NNN system which couples easily with the NNΔ resonance is 1/2. Namely the spin doublet pd channel creates the NNΔ resonance. Similar argument applies to NΔΔ system. Then one summarize: NNΔ resonance : M = 3.07 GeV, JP = (5/2)+. NΔΔ resonance : M = 3.36 GeV, JP = (7/2)+. Both are easy to couple with the spin-doublet pd channel. Assuming the NNΔ and NΔΔ resonance terms, combined with the background ones which are mild in the energy dependence, one analyses the differential cross section and the deuteron tensor polarization of pd -> /sup 3/He π/sup o/ at deuteron incident energy 410 {similar←to} 2200 MeV at $\theta = 0$ and π. The remarkable energy-dependent structure of the tensor polarization is fairly explained by the existence of the NNΔ and NΔΔ resonances.

2150 **(SLAC-PUB—4686) Measurements of $f_1(1285) \rightarrow \pi^+\pi$/sup {minus}/$\pi^+\pi$/sup {minus}/, {eta}/sub c/ → {rho}^{0}{rho}^{0} and {eta}/sub c/ → $f_2(1270)f_2(1270)$ in radiative J/{psi} decays.** Adler, J.; Becker, J.J.; Blaylock, G.T.; Bolton, T.; Brient, J.C.; Brown, J.S.; Bunnell, K.O.; Burchell, M.; Burnett, T.H.; Cassell, R.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Aug 1988. Contract AC03-76SF00515. 4p. (CONF-880867—6). NTIS, PC A02/MF A01. Order Number DE89002069/JAW.

From 24. international Rochester conference on high energy physics; Munich, F.R. Germany (4 Aug 1988).

A measurement of J/{psi} → $\gamma\pi^+\pi$/sup {minus}/$\pi^+\pi$/sup {minus}/ is presented. The $f_1(1285)$ is observed and its spin and parity are investigated. The {eta}/sub c/ is observed to decay to {rho}^{0}{rho}^{0}, and that first observation of {eta}/sub c/ decays to $f_2(1270)f_2(1270)$ is presented. 1 ref., 3 figs.

2151 **(SLAC-PUB—4774) A search for single electron production in e^+e/sup {minus}/ annihilation at 29 GeV.** Steele, T.R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1988. Contract AC03-76SF00515. 3p. (CONF-8808145—2). NTIS, PC A02/MF A01. Order Number DE89002401/JAW.

From Meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT, USA (15 Aug 1988).

A recent search for single electron events performed with the ASP detector at PEP is presented. No anomalous signal is observed and limits on masses of the supersymmetric partners of the electron and photon are obtained. 7 refs., 1 fig.

2152 **D-meson production in 800-GeV/c pp interactions.** Ammar, R.; Ball, R.C.; Banerjee, S.; Bhat, P.C.; Bosetti, P.; Bromberg, C.; Canough, G.E.; Coffin, T.; Dershem, T.O.; Dixon, R.L.; and others. (University of Kansas, Lawrence, Kansas 66045). *Physical Review Letters;* **61**: No. 19, 2185-2188(7 Nov 1988).

We report on a study of the inclusive production properties of D/D-bar mesons in pp collisions at 800 GeV/c and compare our results to measurements made at lower energies and to the expectations of the QCD fusion model.

2153 **Electroweak studies in e^+e^- collisions: $12<\sqrt{s}<46.78$ GeV.** Adeva, B.; Anderhub, H.; Ansari, S.; Becker, U.; Becker-Szendy, R.; Berdugo, J.; Boehm, A.; Bourquin, M.; Branson, J.G.; Burger, J.D.; and others. (III. Physikalisches Institut, Technische Hochschule, D-5100 Aachen, Federal Republic of Germany Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 9, 2665-2678(1 Nov 1988).

The Mark J Collaboration at the DESY e^+e^- collider PETRA presents results on the electroweak reactions $e^+e^-\rightarrow\mu^+\mu^-$ tau$^+$tau$^-$,$\mu^+\mu^-\gamma$, and $e^+e^-\mu^+\mu^-$. The c.m. energy range is 12 to 46.78 GeV. In the $\mu^+\mu^-$ and tau$^+$tau$^-$ channels the total cross sections and the forward-backward asymmetries are reported and compared with other experiments. The results are in excellent agreement with the standard model. The weak-neutral-current vector and axial-vector coupling constants are determined. The values for muons and tau's are compatible with universality and with the predictions of the standard model. In the $\mu^+\mu^-\gamma$ channel, all measured distributions, including the forward-backward muon asymmetry, are in excellent agreement with the electroweak theory. Our data on the two-photon process, $e^+e^-\mu^+\mu^-$, agrees with QED to order α^4 over the entire energy range and the Q^2 range from 0.7 to 166 GeV^2.

2154 **Investigation of the total charm-pair cross section in nonresonant e^+e^- annihilations at $\sqrt{s}$ = 10.5 GeV.** Bowcock, T.; Kinoshita, K.; Pipkin, F.M.; Procario, M.; Wilson, R.; Wolinski, J.; Xiao, D.; Haas, P.; Hempstead, M.; Jensen, T.; and others. (Harvard University, Cambridge, Massachusetts 02138). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 9, 2679-2686(1 Nov 1988).

We report results from two new methods for measuring the total production of charmed particles in nonresonant e^+e^- annihilations at $\sqrt{s}$ = 10.5 GeV. The rate for detection of events containing two reconstructed charmed mesons relative to that for events containing one is used to extract information about total charm production independent of decay branching fractions. The value of ΔR/sub c//sub c-bar/, the total charm-pair cross section normalized to the pointlike μ-pair cross section, is found to be 1.13/sub -0.13//sup +0.17/ +- 0.09, under an assumption of limited particle correlations. In an independent analysis the inclusive cross section for $e^+e^-\rightarrow$qq-bar→e/sup +- /X is measured to be 0.293 +- 0.017 +- 0.017 nb. Using measured relative production rates and semileptonic branching fractions of D^0 and D^+ mesons and estimates of these quantities for D/sub s/ and Λ/sub c/, this is found to correspond to ΔR/sub c//sub c-bar/ = 2.07 +- 0.12 +- 0.26. These two measurements are discussed in the context of measurements made

by reconstruction of exclusive hadronic decay modes and of theoretical expectations.

2155 Search for the decays K/sub L/^{0}→μe and K/sub L/^{0}→ee. Cousins, R.D.; Konigsberg, J.; Kubic, J.; Melese, P.; Rubin, P.; Slater, W.E.; Frank, J.S.; Hart, G.W.; Kinnison, W.W.; Lee, D.M.; and others. (University of California, Los Angeles, California 90024). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2914-2917(1 Nov 1988).

We have obtained upper limits for the decays K/sub L/^{0}→μe and K/sub L/^{0}→ee. The limits on the branching ratios are B(K/sub L/^{0}→μe) <1.1 x 10/sup -8/ and B(K/sub L/^{0}→ee)<1.1 x 10/sup -8/ (90% C.L). In a simultaneous search for the previously observed decay K/sub L/^{0}→μμ, we have identified two events.

2156 Comparison of low-P/sub T/ photon production in high- and low-multiplicity collisions at the CERN ISR. Akesson, T.; Albrow, M.G.; Almehed, S.; Anassontzis, E.; Batley, R.; Benary, O.; Boeggild, H.; Botner, O.; Breuker, H.; Burkert, V.; and others. (Brookhaven National Laboratory, Upton, New York 11973 Cambridge University, Cambridge, United Kingdom CERN, Geneva, Switzerland Institute of Moscow Engineering Physics, Moscow, Union of Soviet Socialist Republics Institute of Nuclear Physics, Novosibirsk, Union of Soviet Socialist Republics Niels Bohr). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2687-2694(1 Nov 1988).

Low-transverse-momentum photon production at the CERN ISR is compared in high- and low-multiplicity events. High-transverse-energy pp collisions and low-multiplicity αα and pp collisions are studied. Relative photon-to-charged-track production is found to be the same in pp minimum bias, αα minimum bias, and pp high-transverse-energy collisions, to within 15%. No low-P/sub T/ excess is seen; the limits are dominated by systematic uncertainties.

2157 Measurements of J/psi decays into a vector and a pseudoscalar meson. Coffman, D.; Dubois, G.P.; Eigen, G.; Hauser, J.; Hitlin, D.G.; Matthews, C.G.; Richman, J.D.; Wisniewski, W.J.; Zhu, Y.; Burchell, M.; and others. (California Institute of Technology, Pasadena, California 91125). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2695-2705(1 Nov 1988).

We present measurements of the two-body decays of the J/psi into a vector and a pseudoscalar meson. The data, taken with the Mark III detector at the SLAC e^+e^- storage ring SPEAR, consist of 5.8 x 10^6 produced J/psi's. The branching ratios for the J/psi decays into rhoπ, rhoeta, rhoeta', ωπ^0, ωeta, ωeta', phieta, phieta', and K/sup */K are measured; an upper limit on J/psi→phiπ^0 is obtained. Using the measured branching ratios we obtain parameters of a phenomenological model of J/psi decays, indicating that the eta and eta' are consistent with being composed only of light and strange quarks. The model is used to obtain the mixing angle in the pseudoscalar nonet. The ωπ^0 electromagnetic form factor is determined. The upper limit on J/psi→phiπ^0 is used to study the contributions from electromagnetic doubly—Okubo-Zweig-Iizuka—suppressed decays of the J/psi. .AE

2158 Large-angle πip elastic scattering at 66.8 MeV. Brack, J.T.; Kraushaar, J.J.; Rilett, D.J.; Ristinen, R.A.; Ottewell, D.F.; Smith, G.R.; Jeppesen, R.G.; Stevenson, N.R. (Nuclear Physics Laboratory, Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 5, 2427-2429(Nov 1988).

Pion-proton elastic scattering measurements at six angles from 101° to 147° center of mass at 66.8 MeV verify previously published differential cross sections which are at variance with earlier data of others and with generally accepted phase-shift solutions which incorporate these earlier data. The present single-arm measurements were made with solid targets and an array of scintillation counters which measured the time of flight of scattered pions.

2159 Search for the decay K^+→$π^+$ $μ^+$ e^-. Campagnari, C.; Alliegro, C.; Chaloupka, V.; Cooper, P.S.; Egger, J.; Gordon, H.A.; Hadley, N.J.; Herold, W.D.; Jagel, E.A.; Kaspar, H.; and others. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **61**: No. 18, 2062-2065(31 Oct 1988).

We report here on a search for the lepton-family-number-violating decay K^+→$π^+$ $μ^+$ e^-. We found no evidence for this decay mode and we establish an upper limit on its branching ratio of 1.1 x 10/sup -9/ at the 90% confidence level (C.L.) for a uniform phase-space decay distribution. We also use this result to establish an upper limit for the branching ratio of the decay $π^0$→$μ^+$ e^- of 7.8 x 10/sup -8/ (90% C.L.).

2160 (ORNL/tr—88/31) Measurement of the hadronic background in the identification of muons. Leuchs, R. (Technische Hochschule Aachen (Germany, F.R.)). 1988. Contract AC05-84OR21400. Translation of German Diploma Thesis, October 1982. 111p. NTIS, PC A06/MF A01. Order Number DE89001417/JAW.

A 2 {times} 2 m²-sized prototype of the muon detector for the UA1 experiment at the pp storage ring of the European Nuclear Research Center CERN was tested in a negative pion beam with 10 GeV/c momentum. The muon detector consists of drift tubes with an optimized, simple electric field configuration. The spatial resolution of the drift tubes lies between 0.2 and 0.3 mm for perpendicular particle incidence, and decreases up to 1 mm for an incidence angle of 60{degree}. Non-linearities in the location-time relation are explainable from the shape of the electric field. The hadronic punch-through was studied in connection with the calorimeters of the UA1 experiment. This punch-through forms a strong source of background in muon identification. In the momentum range from 2 GeV/c to 10 GeV/c and an equivalent calorimeter thickness of 102 cm of iron the probability for hadronic punch-through W/sub h/ is described. W/sub h/ is taken with respect to an incident pion. By inserting additional calorimeters, each equivalent to 24.3 cm of iron, the punch-through is reduced by a factor of 1/3. Only at high particle momenta above 5 GeV/c does the information from the calorimeters make punch-through suppression possible. At lower momenta in the range of 2 to 3 GeV/c an angle cut for the tracks in the muon detector as reconstructed in two projections is very effective. This suppresses the punch-through by a factor of 20 to 50, without losing more than 5% of the muons with a momentum greater than 10 GeV/c. 36 refs., 46 figs., 5 tabs.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 2014, 2231, 2336, 2366

2161 (DOE/ER/05490—93) Research in elementary particle physics: Progress report, March 1, 1988 to February 28, 1989. Chan, Lai-Him; Haymaker, R.; Imlay, R.; Metcalf, W. (Louisiana State Univ., Baton Rouge (USA)). 1988. Contract AS05-77ER05490. 151p. NTIS, PC A08/MF A01. Order Number DE89001905/JAW.

We describe theoretical work on effective action expansion on an effective low energy theory of hadrons, dynamical symmetry breaking, and lattice gauge theories.

2162 (DOE/ER/40252—3) Theoretical studies of phenomenological models of nuclear chromodynamics: Progress report, January 1, 1988-December 31, 1988. Parmentola, J.A. (West Virginia Univ., Morgantown (USA)). Sep 1988. Contract FG05-86ER40252. 8p. NTIS, PC A02/MF A01. Order Number DE89002013/JAW.

During the first year of our renewed research program significant progress has been made on the following research problems: in computing both elastic and inelastic pion-nucleon scattering phase shifts in the (1,1) and (3,3) channels within our pionic nontopological soliton model; in developing a new method for computing quantum soliton states and energies for all momenta in relativistic quantum field theory; and in applying the subsidiary condition theorem to soliton quantization in relativistic quantum field theory. These topics are discussed in this paper.

2163 **(EFI—959(9)-87) /sup 1/P/sub 1/ heavy quarkonia production in hadron-hadron collisions.** Alanakyan, R.A.; Dul'yan, L.S.; Grigoryan, S.G.; Matinyan, S.G. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704419/JAW.

The production of /sup 1/P/sub 1/-quarkonia (charmonium, bottomonium and toponium) with large transverse momenta is studied in collisions of ultrahigh-energy pp and pp-bar beams. The analysis was carried out in the framework of gluon-gluon fusion mechanism and nonrelativistic quarkonium model. 37 refs.; 8 figs.

2164 **(EFI—969(19)-87) Pseudoscalar boson production in e/sup +/e/sup -/ annihilation.** Grigoryan, S.G.; Chatrchyan, S.A. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704421/JAW.

A mechanism of pseudoscalar boson production by the heavy quark-antiquark pair via one-photon exchange in e/sup +/e/sup -/ annihilation is studied. The total cross sections of this reaction and energy distributions of produced p/sup 0/-boson are obtained. 14 refs.; 9 figs.

2165 **(IAE—4519/1) On a theory of electromagnetic signal from hot quark-gluon plasma.** Nosov, V.G.; Kamchatnov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704450/JAW.

Various distribution functions characterising the thermally irradiated lepton pairs are found under the fixed temperature of electromagnetic transparent plasma volume. It is shown that the energy distribution in the thermal irradiation photon spectrum resmbles the Fermi-distribution of source elementary quark radiators. In actually achievable quark-gluon plasma production situation under the ultrarelativistic nucleus-nucleus collisions the plasma hydrodynamical broadening accompanied by cooling is taken into account. Resulting distribution of electromagnetically interacting paricles by energies and angles in the closed form is found. Taking into account the possible experiment difficulties, leptons and mostly muons appear to be the most accepatable. 15 refs.; 2 figs.

2166 **(IAE—4568/1) Matter-enhanced neutrino spin rotation and the solar-neutrino problem.** Akhmedov, E.Kh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704452/JAW.

It is shown that in the presence of matter there may occur resonant amplification of the flavor-changing neutrino spin rotation in transverse magnetic fields, which is roughly analogous to the Mikheyev-Smirnov-Wolfenstein (MSW) effect in neutrino oscillations. This may result in a strong reduction of the solar neutrino flux, as well as in the anticorrelation between the observed flux and the sun-spot number. The effect can, in principle, be distinguished from the MSW effect, as well as from the flavor-conserving neutrino spin procession. 19 refs.

2167 **(IFVE-OTF—87-24) Light meson spectroscopy.** Plyushchaj, M.S.; Pron'ko, G.P.; Solov'ev, L.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704501/JAW.

A model of a straightline string with quarks on its ends has been constructed. The model spectrum has been compared with the experimental one and candidates for exotic mesonic states have been nominated. A string interaction of the phi/sup 3/ type has been built, which allows to describe meson decays. The procedure of constructing quantum theory of a complete string in 4-dimensional space-time, which opens perspectives for further development of the theory of extended hadrons, is described. 9 refs.; 3 figs.; 1 tab.

2168 **(IFVE-OTF—87-87) R-parity breaking in supersymmetric models.** Kereselidze, A.R.; Liparteliani, A.G.; Volkov, G.G. (Tbilisskij Gosudarstvennyj Univ. (USSR)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704502/JAW.

R-parity breaking is studied in supersymmetrically extended SU(2)xU(1) standard model with soft SUSY breaking terms. Some phenomenological consequences of R-parity breaking, such as: lepton number violation, existence of right-handed currents, breaking of e-μ-tau-universality and neutrino-LSP oscillations, are considered. 21 refs.; 1 tab.

2169 **(IFVE-OTF—88-7) Calculation of ᵛector meson electron widths in QCD using their mass spectrum.** Grigoryan, S.S. (Erevanskij Fizicheskij Inst. (USSR)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704505/JAW.

Submitted to the journal Z. Phys., C.

A QCD sum rules method is discussed which enables one to calculate the electron width of vector mesons from the Γ-, PSI-, PHI- and rho-families, using their mass spectrum. The results of the calculation agree with available experimental data. In the obtained formula for electron widths the corrections ~a/sub s/ play a very essential role, while the contribution from the nonperturbative corrections, related to vacuum condensates of dimension d≦8, is negligible. 37 refs.; 4 tabs.

2170 **(IFVE-OTF—88-8) On a possibility of search for free quarks and nonstandard leptons at e/sup +/e/sup -/ - collider at $\sqrt{s}$ = 90-100 GeV.** Arbuzov, B.A.; Boos, Eh.Eh.; Sultanov, S.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki; AN Azerbajdzhanskoj SSR, Baku. Inst. Fiziki). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704506/JAW.

A possibility to search for free quarks and nonstandard heavy leptons in Z/sup 0/-boson decays is discussed. The variant of incomplete colour confinement is used for estimating quark production probability that predicts the production of heavy b quarks at the enrgy of e/sup +/e/sup -/ collider $\sqrt{}$>or approx.100 GeV. The heavy leptons are considered in the framework of E/sub 6/ symmetry. 10 refs.; 1 tab.

2171 **(IFVE-OTF—88-35) Hadronic production of two-gluino bound states.** Kartvelishvili, V.G.; Tkabladze, A.V.; Chikovani, E.G. (Tbilisskij Gosudarstvennyj Univ. (USSR)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704507/JAW.

The two gluono bound states with different quantum numbers hadronic production and decays are discussed. A possibility to observe such states in the resonance peaks in the invariant mass distributions of two gluonic jets is studied. 11 refs.; 8 figs.

2172 **(IFVE-OTF—88-45) Three-mesonic decays of pseudoscalars from anomalous Ward identity.** Rogalev, R.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704510/JAW.

Submitted to the journal Zeit. Phys. C.

Recently obtained solutions for anomalous Ward identities is used to estimate decay widths eta'->eta$\pi\pi$ and i->KKπ. The eta'->eta$\pi\pi$ amplitude is dependent on total vacuum susceptibility. The experimental data are in agreement with x/sub t/=0. In the presence of a glueball, only the parameters of the current algebra are

not sufficient to evaluate these amplitudes. The three-mesonic decays may be used for the mixing matrix evaluation. 12 refs.; 1 tab.

2173 **(IFVE-OTF—88-59) High energies: again the Poisson distribution?.** Batunin, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704511/JAW.

Submitted to the journal Phys. Lett. .

The development of a gluon cascade with account for the possible inverse process - the coalescence of gluons 2->1 and 3->1 is considered. At asymptotically high energies the stationary Poisson multiplicity distribution is shown to set. 11 refs.; 1 fig.

2174 **(INS—683) Elementary amplitudes of the process π/sup -/p -> K/sup 0/Λ.** Sotona, M.; Zofka, J. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia)). (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1988. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755203/JAW.

The partial wave amplitudes T/sub lj/ for the process πN -> KΛ are constructed from the available experimental data and extensively tabulated here. These amplitudes are essential for obtaining spin-flip and spin non-flip amplitudes (g and f), needed for a correct description of (πK) hypernuclear productions and polarizations.

2175 **(INS—687) Neutral current effect in nuclear β-decays.** Terazawa, Hidezumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755206/JAW.

It is pointed out that the electron energy spectrum in nuclear β-decays is affected by the weak neutral current interaction in nuclei to the order of several eV. The effect may become a serious obstacle to future measurements of the neutrino mass within the accuracy of a few eV but, once observed, it will become very useful for measurements of the weak mixing angle and the quark density in nuclei.

2176 **(INS—688) Neutrino oscillations and the anomalous atmospheric neutrino flux.** Hidaka, K.; Honda, M.; Midorikawa, S. (Tokyo Gakugei Univ., Koganei (Japan). Dept. of Physics). (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1988. 11p. (ICR—165-88-11). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755207/JAW.

We re-analyze the constraints on atmospheric ν/sub e/ and ν/sub μ/ fluxes due to three-neutrino oscillations and investigate the anomalous neutrino fluxes recently observed at Kamiokande. We find that it is difficult to explain the data by ν/sub e/ reversible ν/sub μ/ oscillations alone. We also show that models of three neutrino flavors with neutrino mass squared differences of order 10/sup -2/ eV/sup 2/ can solve both the solar and the atmospheric neutrino problems simultaneously.

2177 **(INS—689) Relation between the average multiplicity and transverse momentum of produced particles in hadron-hadron collisions at very high energies.** Terazawa, Hidezumi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755208/JAW.

It is pointed out that the average charged multiplicity (<n/sub ch/>) and transverse momentum (<p/sub T/>) of produced particles in hadron-hadron collisions at very high energies ($\sqrt{s}$) have a simple relation of <n/sub ch/>/sup 2/<p/sub T/>/$\sqrt{s}$ = constant (= 0.70 +- 0.05) in the generalized Fermi-Landau statistical and hydrodynamical model. The relation is satisfied remarkably well by the experimental data up to the SPS p-p-bar Collider energies and will soon be tested by the Tevatron Collider experiments.

2178 **(ITEF—111(1987)) Partial-wave analysis of diffractively producted 3π system and Deck model.** Zajmidoroga, O.A.; Tarasov, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704574/JAW.

Process of diffractive production of 3PI-system was studied in the framework of Deek model, including 3PI-resonances. Satisfactory description of general distributions in coherent PI/sup -/A->PI/sup -/PI/sup +/PI/sup -/A reaction was obtained. 3PI-resonances A/sub 1/(1/sup +/) and PI/sup '/,PI/sup "/(0/sup -/) were included into the model for describing data of partial-wave analysis. Satisfactory description of intensities of 1/sup +/S and 0/sup -/S basic waves and basic phase differences in PI/sup -/A->PI/sup -/PI/sup +/PI/sup -/A reaction (on Si nucleus) and relative phases in similar reaction on nucleon target was obtained. The true Deck contributuion to intensities of 1/sup +/S and 0/sup -/S basic waves dominates on an average in obtained results. 16 refs.; 10 figs.

2179 **(ITEP—7(1988)) Radiative decay D(1285)->phiγ in potential model and D(1285) and E(1420) meson mixing.** Geshkenbein, B.V.; Grishkin, V.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704581/JAW.

The radiative density D(1285) -> phiγ is studied in a potential model. A term which explicitly violates the Okubo-Zweig-Iizuki rule is introduced into potential model, the value of the term being chosen such that to explain the observed decay width. The value of the mixing angle $\alpha \sim$ -25 deg is found from the potential model calculation and from the measured widths of the decays D -> phiγ and E(1240) -> $\gamma\gamma$. The widths of decays D -> $\omega\gamma$, E -> $\omega\gamma$, E -> phiγ are calculated. 11 refs.

2180 **(ITEP—184(1987)) Explicit analytical expression for transitional current J/sub μ/=U-bar(p',s')γ/sub μ/U(p,s).** Krivoruchenko, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704588/JAW.

Explicit analytical expression for transitional current u-bar (p', s') γ/sub i/ u(p, s), where u(p',s') and u(p, s) are Dirac spinors, is obtained. 1 ref.

2181 **(ITEP—194(1987)) Hadron interactions in quark models.** Narodetskij, I.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704589/JAW.

Some recent developments on the study of quark degrees of freedom in hadron scattering at intermediate energy are reviewed. Physical foundations of the P-matrix approach and the Quark Compound Bag method are discussed including applications to pion-pion, pion-nucleon, nucleon-nucleon and three-nucleon systems. 16 refs.; 5 figs.

2182 **(ITEP—203(1987)) Ferbons.** Okun', L.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704590/JAW.

An algebraic model of creation and annihilation operators is constructed, which combine some properties of fermionic and bosonic operators: they anticommute when particles are in different states and, at the same time, they allow any number of particles in a given state. 1 ref.

2183 (JINR-D—1,2-86-668, pp 319-323) **Peculiarities of correlations and the KNO-scaling violation in region of small and large transverse momenta in hadron-hadron and hadron-nucleus processes.** Kokoulina, E.S.; Kuvshinov, V.I. (AN Belorusskoj SSR, Minsk. Inst. Fiziki). 1987. (In Russian). NTIS (US Sales Only), PC A16/MF A01. Order Number DE88780187/JAW. (CONF-8606164—).

From 8. international seminar on high energy physics problems; Dubna, USSR (19 Jun 1986).

Experimental data on multiplicity distribution (MD) behaviour from 10 GeV to high energe range pp-collisions and at $\sqrt{S}$=540 GeV energy of inelastic singlediffractionless pp-collisions, i.e. within 10-900 GeV energy range, are described by negative binominal distributions (NBD)/Poiar distribution/. In several theoretical approaches, explaining the KNO-scaling violation in hadron-hadron interactions, NBD do not appear. Possible models directly producing NBD are considered. 17 refs.

2184 (JINR-E—2-87-863) **Weak many-body decays of the Λ/sub c//sup +/ baryon.** Kalinovskij, Yu.L.; Kallies, W.; Nasriddinov, K.R.; Sarikov, N.A. (Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704605/JAW.

Submitted to the journal Phys. Lett., B.

The generalized "hard"-meson chiral-Lagrangian method, including pseudoscalar and spin-1 meson interactions with 1/2/sup +/-baryons, is used to calculate two-, three-, and four-body nonleptonic weak decays of Λ/sub c//sup +/. It is shown that the theoretical and experimental ratios of the decay modes are in fair agreement. 6 refs.; 3 figs.; 3 tabs.

2185 (JINR-E—2-87-897) **Breakdown of chiral SU(4)xSU(4) - symmetry and masses of charmed baryons.** Kalinovskij, Yu.L.; Kallies, W.; Kuranov, B.N.; Sarikov, N.A. (Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704607/JAW.

Submitted to the journal Phys. Lett., B.

For the description of the mass spectrum of 1/2/sup +/ and 3/2/sup +/ baryons generalized scheme of Oakes is used. The Oakes scheme is extended to the SU(4)xSU(4) symmetry violation case with the help of an additional rotation around the 10th axis in SU(4)-space. Mass formulae and mass values are obtained for the 1/2/sup +/- and 3/2/sup +/-baryons multiplets. The latter are in good agreement with the available experimental mass data. 8 refs.; 2 tabs.

2186 (JINR-E—2-87-906) **Strong decays of charmed 3/2/sup +/ - and 1/2/sup +/ - baryons.** Kalinovskij, Yu.L.; Kallies, W.; Kuranov, B.N.; Sarikov, N.A. (Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704608/JAW.

Submitted to the journal Phys. Lett., B.

In the framework of the broken chiral SU(4)xSU(4) symmetry strong decays of 3/2/sup +/- and 1/2/sup +/-baryons are considered. In calculation the decay probabilities of the 3/2/sup +/-baryons, the decrease of the decay constant with increasing masses of the decaying baryons is assumed. The obtained results within the expected accuracy of the chiral lagrangian method satisfactorily reproduce the available experimental data. 7 refs.; 2 tabs.

2187 (JINR-E—2-87-911) **Decameron dynamics in the high energy antiproton interaction.** Kopeliovich, B.Z.; Zakharov, B.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; AN SSSR, Moscow. Inst. Fiziki Zemli). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704609/JAW.

Submitted to the journal Phys. Lett. .

Decameron which is a color decuplet-antidecuplet system in crossing channel corresponds to the four-gluon exchange in the lowest order of the perturbative QCD. It does not contribute to imaginary part of the p-barp elastic scattering amplitude because of cancellation between different cuts of the decameron with three-sheet and two-sheet final. But this cancellation does not occur in the multiplicity distribution. Analysis of experimental data up to ISR energies reveals energy independent decameron contribution to three sheet events with cross section 1.5+0.1 mb in accordance with perturbative QCD estimations. 12 refs.; 6 figs.; 1 tab.

2188 (JINR-E—2-87-933) **Fit of gluon self-coupling in QCD with different parametrizations for the deep cross section ratio R=σ/sub L//σ/sub T/.** Kotikov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704610/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Fit of gluon self-coupling is made in QCD for three (n=3, 4, 5) moments of gluon distribution in the region of Q/sup 2/ ~ 50-1000 GeV/sup 2/. The result depends strongly on the parametrization of the ratio R(x, Q/sup 2/)=σ/sub L//σ/sub T/ where σ/sub L/ and σ/sub T/ are cross sections of the longitudinal and transverse photon scattering on a nucleon. The necessity is shown mainly of the logarithmic (not power) violation of the Callan-Gross correlation. X-dependence is also introduced into the parametrization of the ration R(x, Q/sup 2/), which improves the result of the fit. 18 refs.; 2 figs.

2189 (JINR-E—2-88-37) **Confinement and quark structure of light hadrons.** Efimov, G.V.; Ivanov, M.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704611/JAW.

Submitted to International Journal of Modern Physics.

We present a quark confinement model (QCM) for the description of the low-energy physics of light hadrons (mesons and baryons). The model is based on two hypotheses. First, the quark confinement is realized as averaging over vacuum gluon fields which are believed to provide the confinement of any colour objects. Second, hadrons are treated as collective colourless excitations of quark-gluon interactions. The description of strong, electromagnetic and weak interactions of mesons and baryons at the low energy is given from a unique point of view. 18 refs.; 7 figs.; 2 tabs.

2190 (JINR-R—2-87-882) **Gluonium mass spectrum in the quasipotential approach.** Dvoeglazov, V.V.; Skachkov, N.B. (Saratovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704632/JAW.

On the basis of the Kadyshevsky quasipotential approach, a set of partial equations is derived for the wave function of the gluonium, a bound state of two gluons. The quasiclassical quantization condition for relativistic two-particle states and the above set are used to calculate the gluonium energy level. In the present work, calculations are made both for linear and quadratic lock potentials. 24 refs.; 1 fig.; 1 tab.

2191 (JINR-R—2-87-934) **Test for three-gluon vertex in quantum chromodynamics.** Kotikov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704634/JAW.

Submitted to the journal Phys. Lett. .

The necessity of self-coupling (i.e. the existence of the three-gluon vertex) for the agreement between the theoretical and "experimental" Q/sup 2/-evolution of gluon distribution in a nucleon is shown. The result is obtained for three (n=3,4,5) moments of gluon distribution in the region of Q/sup 2/ ~ 50-1000 GeV/sup 2/, where different power (over Q/sup 2/) corrections could be neglected. 10 refs.; 1 fig.

2192 **(JINR-R—2-88-8) Narrow pair correlations and bound state generation in the model of one-particle sources.** Lyuboshits, V.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704635/JAW.

Submitted to the journal Yad. Fiz. .

Two-particle bound state production processes and the structure of narrow correlations in a continuous energy spectrum for interacting particles are analysed in the framework of the united approach. A general connection between the inclusive cross sections of compound system production and the double inclusive cross sections of component particle pair generation with close 4-velocities is discussed. The transition to the model of one-particle sources is investigated. On the basis of this model, the quantum-mechanical formulae are obtained describing the dependence of the probability of deuteron production in collisions of hadrons with nuclei on spcetime dimensions of the nucleon generation region and on the parameters of low-energy triplet neutron-proton scattering. the coalescence coefficient has been calculated in the case of the spherical-symmetric Gaussian distribution of sources and also for the nucleon production region which takes the form of narrow "tube" lengthways the trajectory of a primary hadron in nuclear matter. 36 refs.; 1 tab.

2193 **(LU-TP—87-3) Lund Monte Carlo for Hadronic Processes - PYTHIA version 4.8.** Bengtsson, H.U.; Sjoestrand, T. (UCLA, Los Angeles (USA); Lund Univ. (Sweden)). (Lund Univ. (Sweden). Dept. of Theoretical Physics; California Univ., Los Angeles (USA). Dept. of Physics). Jan 1987. 35p. (UCLA—87-001). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755125/JAW.

PYTHIA is a Monte Carlo program intended for the study of high-p/sub T/ physics in hadronic interactions, but covers also the domain of low-p/sub T/ interactions as an integral part of the total cross-section. In its present form, version 4.8, it includes matrix elements for the basic 2 to 1 and 2 to 2 standard model (strong and electroweak) subprocesses (as well as some non-standard model subprocesses), elastic and diffractive scattering, multiple interactions, structure functions and initial and final state parton showers. In this paper, the physics assumptions are summarized, and a detailed manual on how to use the program is given. (authors).

2194 **(N—88-26185) Accuracy of analytic energy level formulas applied to hadronic spectroscopy of heavy mesons.** Badavi, F.F.; Norbury, J.W.; Wilson, J.W.; Townsend, L.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1988. 26p. (NASA-TM—4042; L—16434; NAS—1.15:4042). NTIS, PC A03/MF A01.

Linear and harmonic potential models are used in the nonrelativistic Schroedinger equation to obtain article mass spectra for mesons as bound states of quarks. The main emphasis is on the linear potential where exact solutions of the S-state eigenvalues and eigenfunctions and the asymptotic solution for the higher order partial wave are obtained. A study of the accuracy of two analytical energy level formulas as applied to heavy mesons is also included. Cornwall's formula is found to be particularly accurate and useful as a predictor of heavy quarkonium states. Exact solution for all partial waves of eigenvalues and eigenfunctions for a harmonic potential is also obtained and compared with the calculated discrete spectra of the linear potential. Detailed derivations of the eigenvalues and eigenfunctions of the linear and harmonic potentials are presented in appendixes.

2195 **(PNL-SA—15839) Antimatter, a new frontier of science.** Clayton, E.D. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1988. Contract AC06-76RL01830. 52p. (CONF-8809144—2). NTIS, PC A04/MF A01. Order Number DE89001510/JAW.

From DOE criticality alarm system workshop; Richland, WA, USA (20 Sep 1988).

The interest in antimatter arises because antimatter offers such high potential, and it also happens to be the most fascinating of materials. In the discussions that follow, considerations will be made on the potential utilization of antimatter in various applications including: Alternate energy source for rocket propulsion and space missions; Pion-induced fission; Muon-catalyzed cold fusion; and Medicine: in treatment of cancer, and for superior radiographs. Comments also are provided that presently discount antiproton-proton annihilation as a possible source of negative muons in hypothetical hybrid fusion-fission reactors, but this could change in the future. Reasons are given as to why further exploratory work should be undertaken at this time. 42 refs., 7 figs., 3 tabs.

2196 **(RAL—86-076) Meson dynamics beyond the quark model: a study of final state interactions.** Au, K.L.; Pennington, M.R.; Morgan, D. (Durham Univ., UK). (Rutherford Appleton Lab., Chilton (UK)). Sep 1986. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780110/JAW.

A scalar glueball is predicted in the 1 GeV mass region. The present analysis is concerned with experimental evidence for such a state. Recent high statistics results on central dimension production at the ISR enable the authors to perform an extensive new coupled channel analysis of I = O S-wave 2[2[and KK-bar final states. This unambiguously reveals three resonances in the 1 GeV region - S 3 (991), S 3 (988) and ϵ(900) - where the naive quark model expects just two. These new features are discussed including how they may be confirmed experimentally and their present interpretation. The S 3 (991) is a plausible candidate for the scalar glueball. Other production reactions are examined (heavy flavour decays and 2 2 reactions) which lead to the same final states.

2197 **(RAL—88-058) A-dependence of shadowing and the small-x EMC data.** Close, F.E.; Roberts, R.G. (Tennessee Univ., Knoxville (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA)). (Rutherford Appleton Lab., Chilton (UK)). Jun 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755241/JAW.

We examine the gluon-interaction model for shadowing in the light of the new EMC data on nuclear structure functions. In the model, xsub(n) and xsub(A) characterise the points where shadowing begins and becomes total. Good agreement with the data occurs when xsub(n) varies with A but xsub(A) does not -conversely to the original formulation of the model. The A-dependence of xsub(n) can be described by the same dynamics that generates the A-dependence of the EMC effect at large x.

2198 **(SLAC-PUB—4668) B meson physics with polarized electron beams at the SLC.** Atwood, W.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 5p. (CONF-880983—5). NTIS, PC A02/MF A01. Order Number DE89002067/JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

The expected large cross-section for $e^+e^- \rightarrow Z^0$ and subsequent decay to b{bar b} quarks makes the Z^0 an attractive place to pursue B meson physics. In addition, the big Electroweak asymmetries, thought to exist in Z^0 decays to b{bar b} quarks with polarized electron beams, provide an outstanding handle for observation of such effects as B^0-{bar B}^{0} mixing. In this paper, the feasibility of such measurements is investigated and, with relatively small samples of Z^0's (a few hundred thousand), both B/sub d/ and B/sub s/ meson mixing are shown to be measurable. The subject of CP violation in neutral B mesons is discussed last, but presently such measurements seem to be out of reach. 7 refs., 6 figs., 3 tabs.

2199 (SLAC-PUB—4716) Exclusive processes in QCD and spin-spin correlations. de Teramond, G.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 4p. (CONF-880983—8). NTIS, PC A02/MF A01. Order Number DE89002390/ JAW.

From 8. international symposium on high energy spin physics; Minneapolis, MN, USA (12 Sep 1988).

The unexpected spin behavior observed in hard proton-proton collisions is described in terms of new degrees of freedom associated with the onset of strange and charmed thresholds. The deviation from dimensional scaling laws, the anomalous broadening of angular distributions, and the unusual energy dependence of pp quasielastic scattering in nuclear targets are also consistent with the onset of highly inelastic contributions to elastic pp amplitudes interfering with a perturbative QCD background. The model predicts significant charm production above 12 GeV/c and a relaxation of the spin correlation parameters to their scaling values at higher energies. 13 refs., 3 figs.

2200 Scattering of light by light: Possible experimental detection. Becker, W.; McIver, J.K.; Schlicher, R.R. (Center for Advanced Studies and Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4891-4894(1 Nov 1988).

Moderately upscaled versions of existing free-electron lasers would provide optimal conditions for the detection of scattering of light by light.

2201 Exponentiation of soft photons in Monte Carlo event generators: The case of the Bonneau-Martin cross section. Jadach, S.; Ward, B.F.L. (SLAC, P.O. Box 4349, Stanford, California 94309). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2897-2903(1 Nov 1988).

It is shown, explicitly, how to proceed in the Monte Carlo program in order to include multiple-soft-photon emission. The method is based on the rigorous method of summing infrared contributions to the respective cross section by Yennie, Frautschi, and Suura. Procedures are illustrated on the example of the initial-state bremsstrahlung. One photon is allowed to be hard and an arbitrary number of real soft additional photons are confined to the neighborhood of the infrared point.

2202 Strategies to search for the standard-model Higgs boson at a 1-TeV e^+e^- collider. Burchat, P.R.; Burke, D.L.; Petersen, A. (Santa Cruz Institute for Particle Physics, University of California, Santa Cruz, California 95064). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2735-2741(1 Nov 1988).

We have used detailed Monte Carlo simulations to study strategies to search for the standard-model Higgs boson produced in the reactions $e^+e^-\rightarrow Z^0H^0$ and $e^+e^-\rightarrow \nu/\text{sub e/nu-bar/sub e/H}^0$ at an e^+e^- center-of-mass energy of 1 TeV. We show that it is possible to extract a significant signal from all standard-model backgrounds if the mass of the Higgs boson is not near the mass of the W/sup +- / or Z^0 and is less than 400 (500) GeV when a data sample of 10 (30) fb/sup -1/ has been collected.

2203 Double Higgs-boson bremsstrahlung from W and Z bosons at supercolliders. Barger, V.; Han, T.; Phillips, R.J.N. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2766-2769(1 Nov 1988).

We calculate the production of two standard-model neutral Higgs bosons via bremsstrahlung from a single W or Z boson in pp or e^+e^- collisions at supercollider energies. Observation of these processes would test the predicted HHH, HVV, and HHVV couplings (V = W or Z). For $e^+e^-\rightarrow ZHH$ we extend previous cross-section calculations to a more comprehensive range of energies and Higgs-boson masses, that may be accessible to future machines; we also give final-particle distributions. In the pp case we present the first calculations of the processes $pp\rightarrow HHVX$; the cross sections are comparable to other double Higgs-boson production processes for a range of energies and masses. The presence of W or Z accompanying the Higgs-boson pair has distinct practical advantages for triggering and for separating the final state from backgrounds.

2204 Comparison of exact and effective-gauge-boson calculations for gauge-boson fusion processes. Abbasabadi, A.; Repko, W.W.; Dicus, D.A.; Vega, R. (Department of Physics and Astronomy, Michigan State University, East Lansing, Michigan 48824). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2770-2775(1 Nov 1988).

The exact perturbative calculations for the gauge-boson fusion processes $W^+W^-\rightarrow W^+W^-$, $W^+W^-\rightarrow Z^0Z^0$, and $W^+W^-\rightarrow H^0H^0$ are compared with the corresponding effective-gauge-boson calculations. These comparisons enable us to study the several forms of the gauge-boson distribution functions and draw some conclusions about their nonleading terms. In addition, it is possible to study the effects of various rapidity cuts on the exact and approximate calculations. For rapidity cuts eta/sub C/ satisfying $1.0 \leqq \text{eta/sub C/} \leqq 2.0$, the agreement is excellent. Larger rapidity cuts reveal disagreements of a factor of 2—3 when the invariant mass of the final state is large compared to the Higgs-boson mass. In all cases, the agreement near the Higgs-boson peak is good. The discrepancies are discussed in terms of the extra diagrams which occur in the exact calculation and the t-channel singularities which are present in the effective-gauge-boson calculation.

2205 Cosmic neutrino beams: Probes of lepton and quark substructure. Domokos, G.; Kovesi-Domokos, S. (Department of Physics and Astronomy, The Johns Hopkins University, Baltimore, Maryland 21218). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2833-2840(1 Nov 1988).

X-ray binary systems are expected to emit ultrahigh-energy photons and neutrinos in comparable numbers. Energies of several TeV in the center-of-mass frame in collisions with air nuclei are likely to be present in such beams. These beams can be used to probe the substructure of leptons and quarks by means not available in accelerator-based experiments in the forseeable future. In composite models with leptons and quarks sharing some strongly interacting subconstituents, an increased neutrino interaction cross section is expected above a certain critical energy. Such models lead to some characteristic signatures of the onset of "new physics." Some experiments are proposed to observe the new physics and to test whether the new types of events are caused by neutrinos.

2206 Neutrino masses and the Voloshin-Vysotsky-Okun solution to the solar-neutrino problem. Pulido, J.; Ralston, J.P. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2864-2868(1 Nov 1988).

We analyze the problem of reconciling small neutrino masses with the large electron-neutrino magnetic moment $\mu \sim (0.3—1) \times 10/\text{sup } -10/\mu/\text{sub B/}$ required for the Voloshin-Vysotsky-Okun solution to the solar-neutrino puzzle. The model studied employs interaction between leptons and a charged SU(2)-singlet scalar particle carrying lepton number 2, recently shown able to produce a large magnetic moment by Fukugita and Yanagida. The model possesses zero eigenvalues for the one-loop matrix of mass corrections in several relevant cases. However, imposing an ultraviolet cutoff procedure, the magnitudes of other radiative corrections are too large in each case to allow an acceptable solution even when an optimistic interpretation is given to the cutoff dependence.

2207 Dependence of quarkonium production in proton-nucleus collisions. Hwang, W.P.; Moss, J.M.; Peng, J.C. (Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2785-2796(1 Nov 1988).

A phenomenological model based on information from quarkonium decays is developed to describe quarkonium production in hadron-hadron collisions. The model predictions compare well with the existing proton-induced Y-production data. Since the gluon-fusion process in general is the dominant production mechanism, quarkonium production in nuclei offers the opportunity to probe modification of the gluon distribution of a nucleon in the nuclear environment. We predict the possible A dependence of quarkonium production in proton-nucleus collisions using three models which successfully describe the observed A dependence in deep-inelastic lepton scattering. Our results suggest the possibility of differentiat-

ing these models by use of the A dependence of quarkonium production in proton-nucleus collisions.

2208 **One-loop two-particle scalar-top-quark decay.** Ward, B.F.L. (Department of Physics and Astronomy, The University of Tennessee, Knoxville, Tennessee 37996-1200). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2851-2856(1 Nov 1988).

In certain supergravity-based scenarios the lightest superpartner of the top quark, the lightest scalar top quark, has a rest mass less than that of the top quark itself. Here, we consider such scenarios from the standpoint of the various mass and mixing parameter dependences of the attendant one-loop two-particle scalar-top-quark decay modes. We give a complete set of formulas for assessing these dependences. We illustrate our formulas in a typical model scenario. In this way, the full range of the parameter space relevant to the SLAC Linear Collider and the CERN e^+e^- collider LEP is made accessible.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 2208, 2231

2209 **(JINR-E—2-87-519) Neutral fermions in superstring E/sub 6/-model.** Altajskij, M.V.; Isaev, P.S.; Kovalenko, S.G. (Khar'kovskij Gosudarstvennyj Univ. (Ukrainian SSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704603/JAW.

The mass spectrum of neutral fermion has been studied within the framework of the superstring inspired E/sub 6/-model. The subgroup SU/sub 3C/xSU/sub 2R/xU/sub L/(1)xU/sub R/(1) is contained in E/sub 6/ is considered as an intermediate gauge group surviving after flux breaking. At the intermediate energy scale ~10/sup 11/ GeV it is spontaneously broken. The obtained mass matrix is consistent with weak universality and allows existence of a light, possibly massless, Majorana neutrino and an additional neutral lepton in the spectrum. The mass of the lepton can be in the region of quark masses. 22 refs.; 1 fig.; 2 tabs.

2210 **(JINR-E—5-88-4) Gauge equivalence, supersymmetry and classical solutions of ospu(1,1/1) Heisenberg model and nonlinear Schroedinger equation.** Makhankov, V.G.; Pashaev, O.K.; Myrzakulov, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation; AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1988. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704620/JAW.

Submitted to the journal Lett. Math. Phys. .

An integrable generalization of the continuous classical O(2,1) pseudospin Heisenberg model for the case of the ospu (1,1/1) superalgebra is constructed. The gauge equivalence of the constructed model and the corresponding nonlinear Schroedinger equation (NLSE) is established. We indicate a method of generating classical solutions using the global ospu (1,1/1) supersymmetry. The relationship between solutions of O(2,1) HN and superpartners of NLSE is obtained. 19 refs.

2211 **(RRK—88-18) BRS anomaly and the Weyl freedom in string theory.** Fujikawa, Kazuo; Inagaki, Takeshi; Suzuki, Hiroshi. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jun 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755234/JAW.

It is shown that an anomalous correction to the BRS current $\Delta J/sub\ z/ = (3/4pi]delta/sub\ z//sup\ 2/c/sup\ z/$ in bosonic string theory essentially corresponds to the surface term $(3/8pi]integral\delta/sub\ \alpha/(c/sup\ \alpha/\sqrt{}gR)d/sup\ 2/x$ in the anomalous Jacobian factor. To make this correspondence explicit in the operator level, we present a quantization of a free string at $D < 26$ which maintains the closure of the BRS symmetry.

6454 Field Theory

REFER ALSO TO CITATION(S) 2201, 2205, 2207

2212 **(EFI—970(20)-87) Five-dimensional supersymmetrical expansion of Dirac and chiral electrodynamics.** Egoryan, Eh.Sh.; Manvelyan, R.P. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704422/JAW.

A superinvariant five-dimensional quantum action for Dirac and chiral electrodynamics is proposed in this paper. It is proved that certain reduction to a four-dimensional space will restore the standard unregularized four-dimensional Feynman diagrams of Dirac and chiral electrodynamics. But the supercurrent included in the interaction of five-dimensional theory of chiral (Dirac) fermions is not anomalous, and hence, the five-dimensional action can possibly be a good quantum action for the four-dimensional theory of chiral electrodynamics. 15 refs.; 2 figs.

2213 **(EFI—975(25)-87) To the theory of magnetic charge.** Tevikyan, R.V. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704423/JAW.

A Lagrangian theory for the electric and magnetic charges is constructed. The study is based on a more correct description of the vector particles to which, at $E->\infty$, the limiting fields $j=1, 0, -1, +1$ are connected. The components of the field $j= -1, +1$ are shown to be singular. The Dirac relation is obtained from the Lagrangian. 10 refs.

2214 **(IFVE-OTF—87-195) Exactly and completely integrable nonlinear dynamical systems.** Leznov, A.N.; Savel'ev, M.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 96p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704504/JAW.

Submitted to the journal Acta Applicandae Mathematicae.

The survey is devoted to a consitent exposition of the group-algebraic methods for the integration of systems of nonlinear partial differential equations possessing a nontrivial internal symmetry algebra. Samples of exactly and completely integrable wave and evolution equations are considered in detail, including generalized (periodic and finite nonperiodic Toda lattice, nonlinear Schroedinger, Korteweg-de Vries, Lotka-Volterra equations, etc.) For exactly integrable systems the general solutions of the Cauchy and Goursat problems are given in an explicit form, while for completely integrable systems an effective method for the construction of their soliton solutions is developed. Application of the developed methods to a differential geometry problem of classification of the integrable manifolds embeddings is discussed. For exactly integrable systems the supersymmetric extensions are constructed. By the example of the generalized Toda lattice a quantization scheme is developed. It includes an explicit derivation of the corresponding Heisenberg operators and their desription in terms of the quantum algebras of the Hopf type. Among multidimensional systems the four-dimensional self-dual Yang-Mills equations are investigated most attentively with a goal of constructing their general solutions. 67 refs.

2215 **(INFN-LNF—88/03(RT)) Jet-jet p distributions in the process qq->qqg.** Aversa, F. (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1988. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704515/JAW.

Leading terms in the jet-jet acollinearity distributions corresponding to q/sub i/q/sub j/->q/sub i/q/sub j/g have been considered and compared to corrisponding Drell-Yan distributions. Almost identical behaviour emerges for large CM jet scattering angles, or if the average over all angles is performed. On the other hand differences are expected when the jets are produced at small angles.

2216 (INIS-BR—1281) Topics on field theories at finite temperature. Eboli, O.J.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 216p. (In Portuguese). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88704524/JAW.

The dynamics of a first order phase transition through the study of the decay rate of the false vacuum in the high temperature limit are analysed. An alternative approach to obtain the phase diagram of a field theory which is based on the study of the free energy of topological defects, is developed the behavior of coupling constants with the help of the Dyson-Schwinger equations at finite temperature, is evaluated.

2217 (ITEP—29(1988)) Green-Schwarz action and loop calculations for superstring. Kallosh, R.; Morozov, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704582/JAW.

The authors that Green-Schwartz explicitly 10d supersymmetric and 2d covariant approach without spin 1/2 and 3/2 fields on world sheet may appear suitable for calculations of loops in superstring theory. The way the cancellation of Polyakov anomaly is realized and the answer for 1-loop 4-point amplitudes are reproduced. 18 refs.

2218 (ITEP—40(1988)) Dispersive and damping properties of supersymmetric sound. 1. Lebedev, V.V.; Smilga, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704584/JAW.

It is shown that a supersymmetric medium at nonzero temperature possesses necessarily the massless fermionic collective excitation which we call phonino. Its appearance is due to the spontaneous SUSY breaking at T not = and is as general as the appearance of the sound. The phase velocity of phonino is C=P/E where P is the pressure and E is the energy density of the medium. The Wess-Zumino model is studied in detail. In the case of small temperature, T << m, the authors confirm the general conclusion on phonino existence by analytical calculation summing up the relevant ladder graphs. The summation is equivalent to solving the Bethe-Salpeter equation. Determination of phonino spectrum from this equation is quite analogous to that of the sound spectrum from the kinetic equation. The nonlinear corrections to the lowfrequency dispersion law are found and the damping is estimated. Phonino damping coming from the collision term in the kinetic equatioon is suppressed as g/sup 2/, where g<<1 is the coupling constant, and small. The gauge supersymmetric theories are also discussed. 15 refs.; 11 figs.

2219 (ITEP—41(1988)) Dispersive and damping properties of supersymmetric sound. 2. Lebedev, V.V.; Smilga, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704585/JAW.

This paper is the second part of the work devoted to the massless fermionic collective excitation in supersymmetric media at nonzero temperature. The solution to generalized kinetic equations for the Wess-Zumino model at low temperatures is presented and the situation at high temperatures is discussed. Supersymmetric gauge models are also discussed. 19 refs.

2220 (ITEP—44(1988)) Fading of classical oscillations in quantum decay of false vacuum and the invisible axion constant. Voloshin, M.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704586/JAW.

It is shown that the ultrarelativistic growth of bubbles of new phase in the course of false vacuum decay gives rise to effective fading of residual oscillations of fields around the stable values in the new phase. The damping rate corresponds to constant total energy of the oscillations inside the bubble. It is argued that as a possible consequence of this behavior under certain assumption about phase transition in QCD the amplitude of the coherent invisible axion wave can be at present much less than it is usually estimated. As a result the upper bound for the axion constant can be relaxed from f/sub a/ <or approx. 10/sup 12/ GeV up to f/sub a/ <or approx. 3x10/sup 16/ GeV. 9 refs.

2221 (JINR-E—2-87-883) Degenerate gauge conditions, generalized Gribov's ambiguity and BRST symmetry. Fabbrichesi, M.E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704606/JAW.

Submitted to the journal Phys. Lett. .

The BFS-BRST approach to gauge theories is considered. It is argued that the BRST-invariant boundary conditions ordinarily used do not maintain the necessary degeneracy in the gauge fixing. As a by-product of this discussion, the existence of a generalized Gribov-like ambiguity is suggested. This ambiguity is however shown to be just a particular BRST transformation. 9 refs.

2222 (JINR-R—2-86-724) On the direct method of deriving multi-soliton solution for the problem of wave interaction on the x,y plane. Mel'nikov, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780120/JAW.

Explicit expressions are found for a multi-soliton solution of the system of equations describing the wave interaction on the x, y plane. Though the ideas underlying the inverse scattering method were used to derive this solution, the proofs of the statements made in this paper are based only on the properties of matrices of a special form and have no relation to the above-mentioned method. The obtained results are closely connected with some problems of hydrodynamics and plasma physics. 5 refs.

2223 (JINR-R—2-88-10) Solutions of Dirac equations in spinor space. Yamaleev, R.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1988. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704636/JAW.

It is shown that the spinor nature of Dirac equation is a consequence of spinor structure of components of 4-vector momentum. On the basis of Klein-Fock identity equation of motion for particles with spin h/2 and rest mass 2h/Rc (monads) is formulated. Spinor coordinates and momenta carry out the role of operator of creation and annihilation of monads-elementary carries of energy "charge" momentum-angular momentum. It is shown that the law of conservation of angular momentum leads to the concept of expanded space consisting of spinors and spinor tetrads. 19 refs.

2224 (NBI-HE—88-04) Modular invariance and covariant loop calculus. Petersen, J.L.; Roland, K.O.; Sidenius, J.R. (Niels Bohr Inst., Copenhagen (Denmark)). Jan 1988. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88755428/JAW.

The covariant loop calculus provides and efficient technique for computing explicit expressions for the density on moduli space corresponding to arbitrary (bosonic string) loop diagrams. Since modular invariance is not manifest, however, we carry out a detailed comparison with known explicit 2- and 3- loop results derived using analytic geometry (1 loop is known to be ok). We establish identity to 'high' order in some moduli and exactly in others. Agreement is found as a result of various non-trivial cancellations, in part related to number theory. We feel our results provide very strong support for the correctness of the covariant loop calculus approach.

2225 (NBI-HE—88-07) Relativistic gauge model describing N particles bound by harmonic forces. Filippov, A.T. (Joint Inst. for Nuclear Research, Moscow (USSR). Lab. of Theoretical Physics). (Niels Bohr Inst., Copenhagen (Denmark)). Feb 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755429/JAW.

Application of the principle of gauging to linear canonical symmetries of simplest (rudimentary) bilinear lagrangians is shown to produce a relativistic version of the lagrangian describing N particles bound by harmonic forces. For pairwise coupled identical particles the gauge group is T/sub 1/xU/sub 1/xSU/sub N-1/. A model for the relativistic discrete string (a chain of N particles) is also discussed. All these gauge theories of particles can be quantized by standard methods.

2226 **(NORDITA—87/55-P(prepr.)) BRST invariant mixed string vertex for the bosonic string.** Clarizia, A.; Pezzella, F. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). Sep 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755430/JAW.

We construct a BRST invariant (N+M)-string vertex including both open and closed string states. When we saturate it with N open string and M closed string physical states it reproduces their corresponding scattering amplitude. As a particular case we obtain BRST invariant vertex for the open-closed string transition.

2227 **(NORDITA—87/56-P(prepr.)) Infinite class of new conformal field theories with extended algebras.** Ravanini, F. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Istituto Nazionale di Fisica Nucleare, Turin (Italy)). (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Istituto Nazionale di Fisica Nucleare, Turin (Italy)). Oct 1987. 21p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755431/JAW.

A large class of 2D conformal field theories with extended Virasoro algebras related to the GKO construction on the coset SU(2) x SU(2)/SU(2) is introduced. Through a Feigin-Fuchs construction the Kac formula is deduced. Characters of the highest-weight irreducible representations are given in terms of the GKO decomposition branching functions. Modular invariant partition functions are constructed and an A-D-E classification based on a triple of simply-laced Lie algebras is analyzed in detail.

2228 **(NORDITA—88/6-P(prepr.)) BRST invariant operator formalism for the superstring.** Di Vecchia, P.; Hornfeck, K.; Frau, M.; Lerda, A.; Sciuto, S. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Istituto Nazionale di Fisica Nucleare, Turin (Italy); Niels Bohr Inst., Copenhagen (Denmark); State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics; Naples Univ. (Italy). Dipt. di Scienze Fisiche; Istituto Nazionale di Fisica Nucleare, Naples (Italy)). (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Istituto Nazionale di Fisica Nucleare, Turin (Italy); Niels Bohr Inst., Copenhagen (Denmark); State Univ. of New York, Stony Brook (USA). Inst. for Theoretical Physics; Istituto Nazionale di Fisica Nucleare, Naples (Italy)). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755432/JAW.

We write the N-string vertex for the spinning string in a BRST invariant operator formalism. We give a prescription for building multiloop diagrams in superstring theories.

2229 **(SLAC-PUB—4727) Discrete field theories and spatial properties of strings.** Klebanov, I.; Susskind, L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1988. Contract AC03-76SF00515. 13p. (CONF-8805214—1). NTIS, PC A03/MF A01. Order Number DE89002396/JAW.

From Strings '88: superstring workshop; College Park, MD, USA (24 May 1988).

We use the ground-state wave function in the light-cone gauge to study the spatial properties of fundamental strings. We find that, as the cut-off in the parameter space is removed, the strings are smooth and have a divergent size. Guided by these properties, we consider a large-N lattice gauge theory which has an unstable phase where the size of strings diverges. We show that this phase exactly describes free fundamental strings. The lattice spacing does not have to be taken to zero for this equivalence to hold. Thus, exact rotation and translation invariance is restored in a discrete space. This suggests that the number of fundamental short-distance degrees of freedom in string theory is much smaller than in a conventional field theory. 11 refs., 4 figs.

2230 **Algebraic construction of partition functions for c<1 minimal conformal field theories.** Suranyi, P. (Blackett Laboratory, Imperial College, London SW7 2BZ, United Kingdom). *Journal of Mathematical Physics (New York);* **29**: No. 12, 2634-2640(Dec 1988).

Partition functions with periodic and twisted boundary conditions are constructed for c<1 minimal conformal field theories using the modular transformation properties of the characters of the Virasoro algebra alone. The construction helps to clarify the connection between twisted partition functions of c<1 and periodic Gaussian conformal field theories.

2231 **Fermion-number susceptibility in lattice gauge theory.** Gottlieb, S.; Liu, W.; Renken, R.L.; Sugar, R.L.; Toussaint, D. (Department of Physics, Indiana University, Bloomington, Indiana 47405). *Physical Review [Section] D: Particles and Fields;* **38**: No. 9, 2888-2896(1 Nov 1988).

We study the response of the quark number density to infinitesimal chemical potentials in quantum chromodynamics with two flavors of light quarks. We find that both the singlet and nonsinglet susceptibilities give clear signals for the chiral-symmetry-restoration phase transition. They are large and approximately equal in the high-temperature phase, which is consistent with a plasma of light-mass quarks. The quark-number susceptibility is consistent with zero in the low-temperature phase as expected from confinement. For U(1) lattice gauge theory with four flavors of fermions we find that the singlet susceptibility is zero in both the chiral-symmetric and broken phases as expected on theoretical grounds, while the nonsinglet susceptibility jumps at the phase transition.

2232 **Geometric interpretation of the string vertex operator.** Aratyn, H.; Ingermanson, R. (Department of Physics, University of Illinois at Chicago, Box 4348, Chicago, Illinois 60680). *Physical Review Letters;* **61**: No. 18, 2050-2053(31 Oct 1988).

We link the moments of the vertex operator describing photon emission to a vielbein satisfying Maurer-Cartan structure equations connected with the Virasoro algebra. We also discuss string theory in terms of the Abelianized Virasoro operators and describe the consequences of our approach for the structure of the spectrum-generating algebra.

2233 **Simulating lattice QCD at finite density.** Gocksch, A. (Physics Department, University of California at San Diego, La Jolla, California 92093). *Physical Review Letters;* **61**: No. 18, 2054-2057(31 Oct 1988).

A new method of simulating systems with a complex action which was recently introduced is applied to lattice QCD at finite density. At infinite gauge coupling we obtain a phase diagram which, in nice agreement with mean-field theory, gives a critical value of the chemical potential unrelated to the baryon mass. At the same time we demonstrate explicitly the failure of the quenched approximation.

2234 **Nature of the deconfining phase transition in SU(3) lattice gauge theory.** Brown, F.R.; Christ, N.H.; Deng, Y.; Gao, M.; Woch, T.J. (Department of Physics, Columbia University, New York, New York 10027). *Physical Review Letters;* **61**: No. 18, 2058-2061(31 Oct 1988).

Monte Carlo calculations on lattices with large spatial volume show that the SU(3) deconfining phase transition is more weakly first order than previously thought. We have studied the transition for N/sub T/ = 4 and 6 on lattices of spatial volume 16^3, 20^3, and 24^3. The 24^3 x 4 calculations show a sharp first-order phase

transition, yielding a latent heat ΔscrE/T⁴ of 2.54 +- 0.12. The 24³ x 6 calculations suffer greater finite volume smearing, but suggest that ΔscrE/T⁴ = 2.48 +- 0.24. Correlation lengths increase significantly near the transition, and the energy plus pressure of the ordered phase depends strongly on β. .AE

65 PHYSICS II

6510 Nuclear Physics

2235 **(DOE/ER/40071—T1) Theoretical research in intermediate energy nuclear physics: Final report.** Seki, R. (California State Univ., Northridge (USA). Dept. of Physics and Astronomy). 4 Dec 1987. Contract AC03-82ER40071. 9p. NTIS, PC A02/MF A01. Order Number DE89002007/JAW.

This paper discusses the progress that has been made on the following problems: a numerical calculation of Skyrmiron scattering; (e,e'p) at high momentum transfer; spin-orbit nucleon-nucleon potential from Skyrme model; pionic atom anomaly; and field theory problems. The problems deal with various topics in intermediate-energy nuclear physics.

2236 **(ECN—207) REAC-ECN-3 data library with neutron activation and transmutation cross-sections for use in fusion reactor technology.** Gruppelaar, H.; Kamp, H.A.J. van der; Kopecky, J.; Nierop, D. (Netherlands Energy Research Foundation, Petten). May 1988. 220p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88704417/JAW.

The work performed to revise the REAC data file of Mann et al., containing cross-sections for neutron activation and transmutation reactions for use in fusion-reactor technology, is described. The revisions were made by means of renormalizations of the cross-sections to experimental data at 14.5 MeV or to data from 14.5 MeV systematics. Uncertainty estimates are given for the systematics. Furthermore, a number of reactions have been added. The file essentially contains cross-sections for almost all stable and unstable nuclides with half lives exceeding 1 day. If a reaction can produce one or two isomers the cross-sections for producing the ground and isomeric states are given separately. In most cases these cross-sections were obtained by a simple scaling using isomer ratios at 14.5 MeV, based upon experimental data or recently developed systematics. For about 50 reactions leading to long-lived states a special treatment was followed including a detailed uncertainty analysis. The revised file is called REAC-ECN-3. A version with multigroup cross-sections has also been generated (GREAC-ECN-3). The report contains an Appendix with 14.5 MeV cross-sections for all isotopes considered in the data file. 7 figs.; 29 refs.; 5 tabs.; 1 appendix.

2237 **(IAE—4318/2) Physical basis and a technique of experiment on K-meson interferometry in interactions of high energy nuclei.** Gersh, Kh.U.; Antonenko, V.G.; Vasil'ev, M.A.; Grigor'yan, Yu.I.; Man'ko, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704448/JAW.

Project of experiment on interferometry of K/sup +/- mesons emitted during interaction of nuclei with several GeV/nucleon energy is suggested. The knowledge of correlation function enables to make conclusions about fireball space-time evolution in a "hot" phase. Experiment is assumed to be conducted in JINR synchrotron. Magnetic spectrometer-identificator (SIM) with coordinate multiwire chambers, created at present, will be used as experimental facility. The paper contains brief consideration of identical particle interference, calculation of expected yield of kaon pairs, evaluation of physical background. Technique for measuring and primary analysis for the choice of events is suggested. Calculations show that about 10/sup 7/ events with K/sup +/-meson escape must be recorded for analysis during 150-200 h of accelerator operation. (2-3)X10/sup 4/ events out of them will correspond to kaon pair yield. This statistics is sufficient in order to obtain the correlation function in 0<or approx.q<or approx.300 MeV/c range of transfered momentum with 20 MeV/c step and 3-5% accuracy. 27 refs.; 12 figs.

2238 **(IAE—4435/2) Invariant cross sections of tritons emitted in the interactions of /sup 12/C and /sup 3/He nuclei with different targets.** Adyasevich, B.P.; Antonenko, V.G.; Golutvina, I.G. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704449/JAW.

Invariant cross sections of tritons emitted in the interactions of /sup 12/C nuclei with Cu, Sn and Pb targets at 3.60 GeV/nucl. and /sup 3/He nuclei with Pb target at 4.9 GeV/nucl. are presented. 5 refs.; 4 figs.; 4 tabs.

2239 **(IFUSP-P—602) Nuclear physics with electromagnetic probes.** Arruda Neto, J.D.T. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1986. 43p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704487/JAW.

The potentiality of electron accelerators for investigating nuclear structures is presented. Several examples of electron scattering in coincidence and their principal characteristics, are discussed. (M.C.K.).

2240 (INIS-SU—68, pp 51) **Resonance excitation of nuclear levels by γ-quanta from the (n,γ) reaction.** Begzhanov, R.B.; Gladyshev, D.A.; Kobilov, O.Sh.; Kulabdullaev, G.A.; Razzakova, N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2241 **(INIS-SU—68) Nuclear spectroscopy and nuclear structure. Summary of reports.** (AN SSSR, Moscow; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; AN Azerbajdzhanskoj SSR, Baku; Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya Azerbajdzhanskoj SSR, Baku; Azerbajdzhanskij Gosudarstvennyj Univ., Baku (USSR)). 1988. 103p. (In Russian). (CONF-8804216—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW.

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

Individual summaries in these proceedings are indexed separately. (LEW)

2242 **(JAERI-M—88-140) Nuclear cross section calculation system with simplified input-format, version I. SINCROS-I.** Yamamuro, Nobuhiro. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa (Japan). Nuclear Research Lab.). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 79p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755232/JAW.

To calculate the nuclear cross sections with a statistical and preequilibrium model as efficiently and easily as possible, a calculation system with simplified input-format has been developed. The system is composed of the ELIESE-GNASH joint program and the DWUCK program. A set of global optical model potential parameters is programmed in the codes. The discrete level data are prepared from ENSDF file after correction and input-format conversion. Using the present version, neutron cross sections for 25 nuclides covering the range from /sup 27/Al to /sup 109/Ag were calculated up to 20 MeV. As the result of general agreements with experimental data for wide mass range, the availability of the present version is proved.

2243 (JINR—16-87-486) Induced radioactivity of thick copper and lead targets irradiated by protons, /sup 4/He and /sup 12/C nuclei with energy of 3.65 GeV/nucleon. Astapov, A.A.; Bamblevskij, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of Radiation Safety). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704598/JAW.

Submitted to Organization commetti of 1. All-union conference of young scientists Accelerators of charged particles and radiation physics, Moscow, 5 - 11 Sep 1987.

Experimental results of temporal distributions of γ-dose rate D(t) from induced radioactivity of copper and lead targets with 100X130 mm/sup 2/ and 100X170 mm/sup 2/ dimensions, respectively are presented. The copper target was irradiated by /sup 4/ He and /sup 12/C ions, the lead one - by protons and /sup 12/C ions with 3.65 GeV/nucleon energy. D(t) values were defined by means of scintillator detector with NaJ(Tl) crystal having 63X63 mm/sup 2/ dimensions. To evaluate the d/sub A/(t) dose rate from induced radioactivity of the target of a certain dropped nucleon with atomic weight A expression d/sub A/=KXAXd/sub p/ can be applied, where d/sub p/-analogous quantity for protons of the same energy per nucleon, and K accounts distinction in quantity of inelastic interaction in target of protons and nuclei. A relative contribution calculated by the Monte-Carlo method, for primary and secondary particles in d/sub p/ dose rate calculation values of d/sub A/, recieved with accuracy to coefficient 2, coincide with experimental results. 8 refs.; 6 figs.

2244 (JINR-E—1-87-472) Particularities of neon-22 nuclei inelastic interactions with emulsion at 4.1 A GeV/c. El-Naghy, A.; Krasnov, S.A.; Shabratova, G.S. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704601/JAW.

Submitted to the Intern. Conf. on Ultrarelativistic Nucl.-Nucl. Collisions. Quark Matter - 1987, GFR, Aug. 1987.

From the analysis of the transverse momentum distribution and azimuthal angle correlations for fragments of the projectile nucleus a residual nucleus of the projectile is shown to acquire a large ~0.4 GeV/c transverse momentum in collisions of neon-22 nuclei with emulsion. The azimuthal asymmetry for all particles (side-splash) is observed in central collisions with heavy emulsion nuclei. The class of events called particular events where the particles with azimuthal collinearity coefficient $\beta > 0.7$ are not observed at angle less than (6-12)deg relative to the direction of flight of the projectile, has been also found among the central collision events. The tendency to emission in the opposite direction in the azimuthal plane of colliding nuclear fragments, target nucleus fragments and produced particles is observed. This tendency increases with decreasing an impact parameter. These effects are not described by the cascade-evaporation model. 6 refs.; 3 figs.; 4 tabs.

2245 (JINR-R—1-87-546) Observation of collective particle flux in /sup 22/Ne nuclei collisions with Ag and Br in a photoemulsion at 4.1 AxGeV/c momentum. Bannik, B.P.; Krasnov, S.A.; Tolstov, K.D. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704624/JAW.

Submitted to the journal Z. Phys. .

In the collisions of 4.1 AXGeV/c /sup 22/Ne with Ag, Br emulsion nuclei, events exhibiting projectile and target fragmentation have been selected. The characteristic of these events are not reproduced by the cascade-evaporation model. The angular distribution and correlation between projectile and target fragments have shown the "bounce off" of the former and the "side splash" of the latter. 18 refs.; 6 figs.; 2 tabs.

2246 (JINR-R—3-87-131) Measurement of a probability of electron-positron pair radiation at the capture of thermal neutrons by protons. Borzakov, S.B.; Pokotilovskij, Yu.N.; Khazins, D.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704638/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Measurements were performed by registration of γγ-coincidence spectrum at the capture of thermal neutrons (E=50 MeV) with polyethylene target protons. Gamma-spectra were measured by means of two scintillation detectors with NaI(Tl) crystals. The pair conversion probability value obtained is equal to (5.8 +-2.4)x10/sup -4/. It agrees with up-to-date data on the probability of internal pair conversion at γ-transitions in nuclei and contradicts the recent calculations of this value within the relativistic momentum approximation. The obtained experimental value of probability excludes also the production in this reaction of a short-lived axion with tau/sub a/ < 5x10/sup -11/ s and m/sub a/=1.8 MeV. 12 refs.

2247 (LA—11339-PR) Progress at LAMPF [Los Alamos Meson Physics Facility], January-December 1987. Poelakker, K. (ed.). (Los Alamos National Lab., NM (USA)). Sep 1988. Contract W-7405-ENG-36. 315p. NTIS, PC A14/MF A01. Order Number DE89002108/JAW.

This report is the annual progress report of MP Division of the Los Alamos National Laboratory. Included are brief reports on research done at LAMPF by researchers from other institutions and other Los Alamos Divisions. These reports included the following topics: Nuclear and particle physics; Atomic and molecular physics; Materials science; Radiation-effects studies; Biomedical research and instrumentation; Nuclear chemistry; Radioisotope production and accelerator facilities development and operation.

2248 (LUNFD6-NFFK—7077-1-17) Salient features of heavy ion reactions in the intermediate energy region. Jakobsson, B. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics). Mar 1987. 18p. (CONF-8609159—; CONF-8701149—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755127/JAW.

From International school-seminar on heavy ion physics; Dubna, USSR (23 Sep 1986).

Experimental results from devoted medium energy heavy ion accelerators are beginning to fill up the gap in our knowledge of the heavy ion reaction pattern between the low energy - binary - side and the high energy - participant/spectator - side. This paper is focused on new results on central, violent collisions in the medium energy region. With 42 refs.

2249 (RCNP-P—96) Proceedings of the workshop on few-body systems. (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1988. Vp. (In Japanese). (CONF-8712120—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW.

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

Individual papers in these proceedings are separately indexed. {Lew}

2250 (RCNP-P—97, pp 38-51) $\}_{757}\Omega\pi\ \omega_7\mu\Sigma\gamma\pi\mu\ _8\omega\Lambda\Delta\ \partial\cong\sigma\kappa\theta\rightleftharpoons\cong\mu_3=^+Y\ o\rightleftharpoons\leqq\kappa\Omega\mu\pi^+\pi\Sigma\pi_7\ \Lambda_8\approx=\bullet\mu^+{}_{53}\gamma\ {}_3\Omega_6\ \epsilon=_7\Delta^+{}_{53}\gamma\ \}_7\mu_{73}\omega_5=Y\ >_3\beta\Lambda Y\ \int_3{}^+\pi_3\Delta_3\ \leqq\lambda_3{}^-{}_3\Omega\cong\geqq\rightleftharpoons\ ^{1988}\rightleftharpoons\leqq\kappa\Omega\ \lambda_3{}^-{}_3\Omega_7\mu_7\cong\rightleftharpoons\sigma\sqrt{\kappa}\int\ \leqq<\int\ \int_3\gamma_7\mu\ \xi\Omega\gamma\bullet\cong Y\ \approx\epsilon\ \cong^{08}\pounds\upsilon\delta\ \cong^{01}\rightleftharpoons\ \xi\omega_{67}\omega\ \sigma\Sigma\Delta_{47}\omega\ \Theta\sim^{88780018}\pounds\lambda\cong>\rightleftharpoons\ \leqq\epsilon\xi\sigma\delta\supset^{8712121}\bullet\cong\rightleftharpoons$

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

Recent advent of the intermediate-energy heavy-ion accelerator with high beam intensities at GANIL has opened a new possibility to study nuclei far from stability. Experimental attempts at mapping the existence of nuclides on the nuclear chart have been made extensively by using a projectile fragment separator LISE, and numbers of new isotopes have been discovered in the light-mass region (A < approx 70). Results of these studies show that the drip line has already been reached experimentally for elements up to Z = 20 in the proton-rich side, whereas the neutron drip line has been attained only for Z ≦ 7. Besides, some spectroscopic investigations of unstable nuclei have been made in the light-mass region. These include measurements of beta-decay halflives, and decay mode studies by detecting of delayed neutrons, protons, or gammas. Also the nuclear masses and radii for light unstable isotopes have been measured by using a high-resolution spectrometer

SPEG. Finally, future attempts at more detailed studies of unstable nuclei is mentioned briefly.

2251 (RCNP-P—97) Proceedings of the workshop on clustering aspects in nuclear structures and nuclear reactions. (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1988. Vp. (In Japanese). (CONF-8712121—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW.

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

This meeting deals with both theoretical and experimental aspects of clustering in nuclei.

2252 (SAND—87-8020) AIM: An AMPX module. Harris, J.M.; McDaniel, P.J. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DR00789. 75p. NTIS, PC A04/MF A01. Order Number DE89001838/JAW.

The AMPX code system was originally written for processing nuclear cross sections into forms suitable for radiation codes. The AIM module was intended for converting AMPX master libraries from binary to BCD format and vice versa. The BCD form is less computer dependent than the binary and consequently, is the preferred form for distribution and storage. With the advent of computer networks with processors from different vendors and dissimilar architectures, the BCD form of the library took on an additional role. It has become the intermediate form for the transmission from one computer to another over a network. Rewritten in FORTRAN 77, AIM not only converts between the two forms for AMPX master libraries but also AMPX working libraries and ANISN libraries. It also runs on each type of machine in the network. This manual describes the AIM code and how to use it, and defines each of the library formats in binary and BCD. 1 ref., 3 tabs.

6511 Experimental Techniques

2253 (LA-UR—88-3041) Precision nuclear targets for Drell-Yan cross section measurements at 800 GeV. Gursky, J.C.; Baer, H.; Flick, F.F.; Gallegos, D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 20p. (CONF-8809159—2). NTIS, PC A03/MF A01. Order Number DE89000332/JAW.

From 14. world conference on the International Nuclear Target Development Society; Darmstadt, F.R. Germany (5 Sep 1988).

Targets of iron, tungsten, carbon, and calcium of areal densities 2.3 to 5.8 g/cm^2 were fabricated to high precision for a fixed-target experiment performed in 1988 at Fermilab to measure relative Drell-Yan cross sections. The experiment used 800-GeV protons at an intensity of 2 x 10^{12} protons per 23-second spill. Areal densities were determined to an accuracy of approximately 1 part in 10^4. The calcium targets were vacuum-encapsulated in stainless steel by electron-beam welding. 1 ref., 5 figs., 4 tabs.

2254 (LBL—22316-Rev.) Lectures on pulsed NMR. Pines, A. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 154p. (CONF-860792—1-Rev.). NTIS, PC A08/MF A01. Order Number DE89001264/JAW.

From 100. Fermi school of physics; Varenna, Italy (8 Jul 1986).

These lectures discuss some recent developments in pulsed NMR, emphasizing fundamental principles with selected illustrative applications. Major topics covered include multiple-quantum spectroscopy, spin decoupling, the interaction of spins with a quantized field, adiabatic rapid passage, spin temperature and statistics of cross-polarization, coherent averaging, and zero field NMR. 32 refs., 56 figs.

6512 Nuclear Properties And Reactions, A=1-5, Experimental

2255 (CONF-8806260—1) Nuclear stopping in oxygen-induced reactions at 200 A GeV. Obenshain, F.E.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Dragon, L.; Ferguson, R.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01. Order Number DE89001522/JAW.

From 19. international symposium on multiparticle dynamics - new data and theoretical trends; Arles, France (13 Jun 1988).

Measurements of transverse energy and energy at zero degrees are compared with the results of a Glauber-type multiple collision model calculations. The best fit to the data shows that the degree of nuclear stopping is large. This theoretical model also predicts energy densities and shows how the energy density changes as the projectile and target masses change. 10 refs., 5 figs.

2256 (INS—685) Formation of /sub Λ//sup 4/H hyperfragment from K/sup -/ absorption at rest on light nuclei. Tamura, H.; Yamazaki, T.; Hayano, R.S. and others. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755204/JAW.

Formation of /sub Λ//sup 4/H hyperfragment from K/sup -/ absorption at rest on light nuclear targets was studied by measuring monochromatic π/sup -/ from the two-body decay, /sub Λ// sup 4/H -> /sup 4/He + π/sup -/ The formation probabilities of /sub Λ//sup 4/H from /sup 7/Li, /sup 9/Be, /sup 12/C, and /sup 16/O targets were extracted to be (3.3 +- 0.4) x 10/sup -2/, (1.57 +- 0.18) x 10/sup -2/, (1.00 +- 0.14) x 10/sup -2/, and (0.47 +- 0.08) x 10/sup -2/ per stopped K/sup -/, respectively. Possible mechanisms for such an abundant production of /sub Λ//sup 4/H are discussed.

2257 (INS—686) Compound hypernucleus interpretation of the /sub Λ//sup 4/H formation probabilities in the stopped K/sup -/ absorption. Tamura, H.; Yamazaki, T.; Sano, M.; Yamamoto, Y.; Wakai, M.; Bando, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jun 1988. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755205/JAW.

For the abundant /sub Λ//sup 4/H production observed in the stopped K/sup -/ absorption on light nuclei, a theoretical model is proposed, in which the basic ingredient is formation and fragmentation of a Λ compound nucleus. The estimated /sub Λ//sup 4/H formation probabilities per stopped K/sup -/ are in rather good agreement with the observed values.

2258 (LA—11367-MS) Cross sections for neutron-producing reactions induced by 14.1 MeV neutrons incident on ^{6}Li, ^{7}Li, ^{10}B, ^{11}B, and carbon. Drosg, M.; Lisowski, P.W.; Drake, D.M.; Hardekopf, R.A.; Muellner, M. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 57p. NTIS, PC A04/MF A01. Order Number DE89002104/JAW.

Using the time-of-flight technique, we have measured neutron emission spectra for ^{6}Li, ^{7}Li, ^{10}B, ^{11}B and carbon at an incident neutron energy of 14.1 MeV and at 10 angles between 30{degree} and 143{degree}. Double differential cross sections and their integrated values have been extracted and are presented in tables and graphs. The nonelastic portion of the neutron emission spectra is noticeably higher than expected which may be due to uncertainties in the input library (ENDF/B-IV) used in the Monte Carlo correction for multiple scattering. In particular, the library for ^{11}B appears to be very unrealistic with an integrated elastic cross section which should be higher by 50%. 20 refs., 1 fig., 12 tabs.

2259 (RCNP-P—96, pp 29-33) **OFS and spin analyzing power for /sup 2/H(d, dp)n reaction.** Fukunaga, K.; Kakigi, S.; Ohsawa, T.; Okihana, A.; Sekioka, T.; Nakamura-Yokota, H.; Murayama, T. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

Coincidence energy spectra and spin analyzing powers are observed in the kinematical condition of target breakup quasi free scattering for the /sup 2/H(d vector,dp)n reaction at 59.8 MeV. Angular dependencies of cross section and analyzing power at the peak of QFS bump are very similar to those of elastic scattering. These results are discussed on the basis of four particle scattering theory.

2260 (RCNP-P—96, pp 34-38) **Breakup reactions of /sup 3/He by polarized protons and multiple scattering effect.** Kakigi, S.; Fukunaga, K.; Ohsawa, T.; Okihana, A.; Sekioka, T. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

For the /sup 3/He(p,pp)/sup 2/H and /sup 3/He(p,pd)/sup 1/H reactions at 64.9 MeV, analyzing powers measured in the quasifree scattering (QFS) region are similar to those for the elastic scatterings. The ratio of the cross sections measured in the QFS region to those calculated in the PWIA is reproduced by a calculation taking account of the double scattering effect.

2261 (RCNP-P—96, pp 96-100) **Depolarization parameter K/sub y//sup y'/ in p-/sup 2/H elastic scattering at Ep = 65 MeV.** Nakamura, Masanobu. (Kyoto Univ. (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

The depolarization parameter K/sub y//sup y'/ in the elastic scattering of 65 MeV polarized protons from deuterium has been measured using a newly designed spectrograph and a multi-foil polarimeter. Faddeev calculations using various nucleon-nucleon (N-N) interactions in a separable representation are compared with the data. The measured K/sub y//sup y'/ values are well reproduced by a calculation using the N-N interaction with a tensor force which is adjusted to reproduce the empirical mixing parameter of the /sup 3/S/sub 1/-/sup 3/D/sub 1/ partial waves. A rank-4 separable representation of the Paris potential by means of EST method (PEST) does not reproduce the data well.

2262 (RCNP-P—97, pp 138-141) **Effective ΛNN interactions in light hypernuclei.** Yamamoto, Yasuo. (Tsuru Univ., Yamanashi (Japan)). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

Microscopic cluster models for A = 3 - 9 hypernuclei are calculated with use of Gaussian-type ΛN and ΛNN interactions. Use of the strongly repulsive ΛNN interactions makes it possible to reproduce systematically Λ binding energies of s-shell and light p-shell hypernuclei.

2263 **Pair decay of the 2.2-MeV excited state of the deuteron: Limits on light-particle emission.** Doehner, J.; Last, J.; Arnold, M.; Freedman, S.J.; Dubbers, D. (Physikalisches Institut der Universitaet, D-6900 Heidelberg, West Germany). *Physical Review* [*Section*] *D: Particles and Fields;* **38**: No. 9, 2722-2728(1 Nov 1988).

We have experimentally studied the electron-positron pairs coming from the decay of the unbound deuteron first excited state following cold-neutron capture on hydrogen. The measured branching ratio for pair emission, Γ/sub e//sub e//Γ/sub γ/ = 3.44(14) x 10/sup -4/, is in excellent agreement with internal-pair-emission theory. This result is a strong constraint on theories which suggest the existence of short-lived pseudoscalar particles, such as the "viable axion," heavy enough to decay to electron-positron pairs.

2264 **Forbidden (p,d) pickup to stretched states of /sup 26/Al.** Peterson, R.J.; Yasue, M.; Tanaka, M.H.; Hasegawa, T.; Nisimura, N.; Ohnuma, H.; Shimizu, H.; Ieki, K.; Toyokawa, H.; Iwase, M.; and others. (Institute for Nuclear Study, University of Tokyo, Tanashi, Tokyo, Japan). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2026-2035(Nov 1988).

The /sup 27/Al(p,d)/sup 26/Al reaction has been studied at E/sub p/ = 35 MeV with high resolution to populate known 5^- and 6^- stretched states of d/sub 5/2/-hole—f/sub 7/2/-particle structure, and to obtain the weak spectroscopic factors. These are compared to results also obtained for the /sup 26/Mg(p,d)/sup 25/Mg and /sup 26/Mg(^{3}He,α)/sup 25/Mg reactions to known ($7/2^-$ states. An analysis of these results in the Nilsson scheme exposes the structure of the 6^- stretched states and offers an understanding of the fragmentation of M6 stretched transition strength in /sup 26/Mg, as seen by electron scattering. This work is part of a consistent study of many nuclear reactions to stretched states in mass 26, to serve as a test case for these important single-particle modes.

2265 **Apparent violation of isospin symmetry in the ^{3}H(^{3}He,^{2}H)^{4}He reaction.** Rai, G.; Blyth, C.O.; England, J.B.A.; Farooq, A.; Karban, O.; Rawas, E.; Roman, S.; Vlastou, R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 Department of Physics, University of Birmingham, Birmingham B15 2TT, United Kingdom Royal Signals and Radar Establishment, Malvern, United Kingdom Department of Physics, University of Mecca, Mecca, Saudi Arabia). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2036-2046(Nov 1988).

Angular distributions of the vector analyzing powers for the ^{3}H(^{3}He,^{2}H)^{4}He reaction have been measured over the incident energy range 18—33 MeV. The measurements centered about 18 MeV display a deviation from the antisymmetric shape expected from isospin symmetry. Concentrating on the explanation of the 90° analyzing powers, we report the results of a distorted-wave Born approximation (DWBA) analysis which includes the direct and exchange processes and the spin-orbit potential. It is shown that the anomalous behavior of the 90° vector analyzing powers can be largely explained by the effect of a single F-wave potential resonance which leads to the magnification of the short-range differences between the ^{3}He and ^{3}H wave functions.

2266 **Polarization transfer for inclusive proton-nucleus inelastic scattering at 800 MeV.** Fergerson, R.; McGill, J.; Glashausser, C.; Jones, K.; Nanda, S.; Sun Zuxun; Barlett, M.; Hoffmann, G.; Marshall, J.; McClelland, J.; and others. (Rutgers University, Piscataway, New Jersey 08854). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2193-2200(Nov 1988).

The polarization-transfer observables D/sub N//sub N/, D/sub S//sub S/, D/sub L//sub L/, D/sub L//sub S/, and D/sub S//sub L/ have been measured at 800 MeV for polarized proton inelastic scattering from ^{1}H, ^{2}H, and /sup 12/C with energy losses up to about 400 MeV. The scattering angles in the laboratory were 5°, 11°, and 20°. No large differences between the observables for the three targets were seen. The data for /sup 12/C in the quasielastic region are reasonably well explained by nonrelativistic and relativistic models of one-step quasifree scattering. Specifically nuclear effects appear small in both the quasielastic and delta regions.

2267 **Evidence for narrow structure in the analyzing power of the ^{3}He(p-arrow-right,d)X reaction.** Santi, L.; Barlett, M.; Ciskowski, D.; Garfagnini, R.; Gazzaly, M.M.; Hoffmann, G.W.; Jones, K.W.; Nasser, M.A.; Pauletta, G.; Smith, C.; and others. (University of Udine, Udine, UD 33100, Italy). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2466-2469(Nov 1988).

The differential cross section and the analyzing power A/sub y/ have been measured for the ^{3}He(p-arrow-right,d)X reaction at a deuteron angle of 22° (lab) and a proton momentum of 1.46 GeV/c. Evidence of narrow structure in the missing mass dependence of A/sub y/ was observed. The masses of the maxima are compared with other reports of narrow resonance-like structure and with the predictions of theory. Significant correspondence is found.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

2268 **(EFI—979(29)-87) On the difference of spectra and structure functions of nuclei obtained in inclusive and forward-backward correlation production of cumulative photoprotons.** Alanakyan, K.V.; Amaryan, M.D.; Asryan, G.A. and others. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704424/JAW.

It is shown that if the cumulative photoprotons (CPP) are registered in coincidence with the forward hadrons (noncumulative protons and π-mesons) and without coincidence (i.e. inclusive), then the CPP spectra are different, and in the latter process they are harder. It is also shown that in the former case the structure function of the fragmentation system (FS) in the CPP is enriched with high-momentum component of the FS constituents. 5 refs.; 3 figs.

2269 (INIS-mf—11319, pp 48) **Inelastic excitation of /sup 6/Li in the /sup 6/Li+/sup 12/C system at E/sub cm/=13.33 MEV.** Hnizdo, V.; Carter, J.; Fearick, R.W.; Sellschop, J.P.F.; Kemper, K.W.; Troka, D.E.; Van Verst, S.P. (University of the Witwatersrand, Johannesburg (South Africa). Dept. of Physics; Florida State Univ., Tallahassee (USA)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2270 **(JINR-R—1-87-924) Sizes of cumulative pion and proton formation region according to the data on pC-, pTa- and π/sup -/C-interactions at P/sub p/=10 GeV/c and P/sub π(sup -)/=40 GeV/c.** Armutlijski, D.; Grishin, V.G.; Didenko, L.A. and others. (Joint Inst. for Nuclear Research, Dubna (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704627/JAW.

Two-particle correlations of cumulative pions and protons in pC-, pTa- and π/sup -/C-interactions at P/sub p/=10 GeV/c and P/sub π(sup -)/=40 GeV/c have been analyzed using pictures from the 2m propane bubble chamber. There are indications that the cumulative pions are emitted from a lesser size region than all the others. The accompanying protons are emitted approximately from the region of the same size. 17 refs.; 2 figs.; 3 tabs.

2271 (N—88-24242, pp 13) **Search for bound states of the eta-meson in light nuclei.** Chrien, R.E.; Bart, S.; Pile, P.; Sutter, R.; Tsoupas, N.; Funsten, H.O.; Finn, J.M.; Lyndon, C.; Punjabi, V.; Perdrisat, C.F. (College of William and Mary, Williamsburg, VA (USA)). Feb 1988. NTIS, PC A05/MF A01. (NASA-CR—182891; NAS—1.26:182891).

In Materials science with muon spin rotation. Annual report, 1 March 1987-29 February 1988.

A search for nuclear-bound states of the eta meson was carried out. Targets of lithium, carbon, oxygen, and aluminum were placed in a pion(+) beam at 800 MeV/c. A predicted eta bound state in O-15* (E sub x approx. = 540 MeV) with a width of approx. 9 MeV was not observed. A bound state of a size 1/3 of the predicted cross section would have been seen in this experiment at a confidence level of 3sigma (P is greater than 0.9987).

2272 (RCNP-P—96, pp 16-20) **Polarized proton induced reactions on Li isotopes.** Kuwaori, Norihiko. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

2273 (RCNP-P—96, pp 21-27) **Inelastic proton scattering on Li isotopes.** Tosaki, M.; Fujiwara, M.; Hosono, K.; Noro, T.; Ito, H.; Yamazaki, T.; Ikegami, H. (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

The angular distribution of the cross sections, analyzing powers and spin-flip probabilities leading to the 3/sup +/ and 0/sup +/ states in /sup 6/Li, and the 1/2/sup -/ and 7/2/sup -/ states in /sup 7/Li have been measured in inelastic scattering of 65 and 80 MeV polarized protons. The angular distributions have been surveyed theoretically within the framework of microscopic DWBA model using the Cohen and Kurath wave functions and the M3Y interaction. The calculations reproduced the gross shapes of the experimental data for the 0/sup +/ state, but not those for the 3/sup +/, 1/2/sup -/ and 7/2/sup -/ states, especially the analyzing power data.

2274 (RCNP-P—97, pp 16-17) **High spin states in /sup 16/O.** Okabe, Shigeto. (Hokkaido Univ., Sapporo (Japan). Center for Information Processing Education). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

We restudy structure of /sup 16/O by an orthogonality condition model. We show that this nucleus is a good example of a molecular aligned rotational band in the band crossing model and that the maximum spin of the cluster state is 12/sup +/ and the observed 10/sup +/ state is considered to be dominated by a 4/sup +/(/sup 12/C) channel.

2275 (RCNP-P—97, pp 30-37) **Coupled-channel analyses of light heavy-ion scattering with projectile-target mutual excitation channels.** Sakuragi, Yukinori. (Osaka City Univ. (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

Elastic and inelastic scattering of light heavy-ions, such as /sup 6/Li and /sup 12/C, have been analyzed with coupled-channel calculations which take into account projectile-target mutual-excitation channels. It is shown that the projectile breakup effect is significant on the inelastic scattering to the target excited states as well as on the elastic scattering. It is also found that the inelastic scattering to the 0/sub 2//sup +/ state (7.64 MeV) in /sup 12/C, which has a well-developed 3α-cluster structure, has been found to be affected seriously by the coupling to /sup 12/C -> 3α breakup process. This coupling is indispensable for the consistent description of observed cross section for the inelastic scattering to this state as well as those for the elastic scattering and the inelastic one to the other non-cluster-like excited states in /sup 12/C.

2276 (RCNP-P—97, pp 62-74) **Target breakup of /sup 6,7/Li by proton scattering.** Tosaki, M.; Fujiwara, M.; Hosono, K.; Noro, T.; Ito, H.; Yamazaki, T.; Ikegami, H. (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

The continuum spectra near the target breakup thresholds in the /sup 6,7/Li(p,p') reaction have been studied with 65 and 80

MeV protons. A marked difference in shape between the /sup 6,7/Li(p,p') continuum spectra has been observed, and is interpreted qualitatively in terms of the knockout process (p,pα). The cross section of the continuum is found to decrease rapidly at forward angles. This may suggest that a recoil particle and a spectator are recombined due to the final state interaction effect.

2277 (RCNP-P—97, pp 79-86) **Astrophysical S-factor for radiative capture reactions.** Kubo, Ken-ichi; Kajino, T. (Tokyo Metropolitan Univ. (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

An accurate astrophys

2278 (RCNP-P—97, pp 104-109) **Analysis of /sup 19/F + /sup 12/C, /sup 16/O elastic and inelastic scattering using cluster folding model.** Fujita, H.; Sugimitsu, T.; Sugiyama, Y. (Daiichi Coll. of Pharmaceutical Sciences, Fukuoka (Japan)). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

The angular distributions of the differential cross sections for the elastic and inelastic scattering of the /sup 19/F + /sup 12/C and /sup 19/F+/sup 16/O systems leading to the 1/2/sup +/(g.s.), 5/2/sup +/(0.197 MeV), 3/2/sup +/(1.554 MeV) and 9/2/sup +/(2.780 MeV) states in /sup 19/F were calculated with the coupled-channel method using a cluster folding model. The calculations reproduce well the characteristic features of the experimental data for both systems. The origin of the phase anomaly observed in the present systems is discussed.

2279 (RCNP-P—97, pp 130-133) **Advances in quasi-molecular state study in sd-shell nuclei.** Kubono, Shigeru. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

An experimental way to study quasi-molecular states in /sup 24/Mg is shown, which uses a particle-gamma coincidence technique for the capture-gamma reaction of /sup 12/C + /sup 12/C. Quasi-molecular states in sd-shell nuclei are discussed critically, and some theoretical works are suggested.

2280 (RCNP-P—97, pp 142-145) **Unified understanding of the /sub Λ//sup 9/Be hypernucleus.** Yamada, T. (Kochi Women's Univ. (Japan). Dept. of Applied Science). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

The microscopic (α + 3N + N) + Λ cluster model is applied to achieve a unified understanding of the /sub Λ//sup 9/Be hypernucleus in the energy region up to E/sub Λ/ ≅ 20 MeV.

2281 **Inelastic scattering of pions by /sup 10/B.** Zeidman, B.; Geesaman, D.F.; Zupranski, P.; Segel, R.E.; Morrison, G.C.; Olmer, C.; Burleson, G.R.; Greene, S.J.; Boudrie, R.L.; Morris, C.L.; and others. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 5, 2251-2258(Nov 1988).

The inelastic scattering of 162-MeV pions was studied over the angular range 35° to 100° in the laboratory system and the data were analyzed with a model that incorporates shell-model wave functions into a distorted-wave impulse approximation formalism. Reduced transition probabilities were obtained for low-lying levels and compared with information previously reported. In addition, evidence is obtained for theoretically predicted levels with high spin that have not been observed previously.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

2282 (INIS-SU—68, pp 53) **Measurement of /sup 28/Si nucleus excited state lifetimes by means of interference of roentgen radiation.** Eremin, N.V.; Strizhov, V.F.; Tulinov, A.F.; Ul'yanova, O.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2283 **(JINR-R—1-87-932) Measurement of the /sup 27/Al(/sup 12/C,X)/sup 24/Na reaction total cross section at 3.65 GeV/nucleon.** Damdinsurehn, Ts.; Duka-Zojomi, A.; Kliman, Ya.; Kozma, P.; Tumehndehmbehrehl, B.; D'yachenko, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy; Moskovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704628/JAW.

The results of measurement of the /sup 27/Al(/sup 12/C,X)/sup 24/Na reaction the total cross section at 3.65 GeV/nucleon are presented. The beam flux has been monitored by means of the detection of neutrons fiormed in interaction of primary beam with a convertor. Moreover, the total cross section of the /sup 27/Al(p,X)/sup 24/Na reaction at 3.65 GeV has been measured by the same experimental technique. The values of cross sections 19.0+-1.5 mb and 8.3+-0.7 mb for /sup 12/C nuclei and protons, respectively, are compared with previous data at other energies. 10 refs.; 3 figs.

2284 (RCNP-P—97, pp 25-29) **Excitation of Jπ = 2/sup +/ resonances by /sup 23/Na(p, /sup 12/C)/sup 12/C reaction.** Kimura, Kikuo. (Kyushu Univ., Fukuoka (Japan). Faculty of Science). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

Angular distributions of the /sup 23/Na(p,/sup 12/C/sub g.s./)/sup 12/C/sub g.s./ reaction were analysed using parametrized S-matrix elements. It was found that the partial cross sections proceeding through J = 2 compound nuclear states of /sup 24/Mg exhibit correlated structures with the 'fissioning resonances' recently observed by the /sup 12/C(/sup 12/C,γ/sub 0/) and /sup 24/Mg(α,α')/sup 12/C/sub g.s./ + /sup 12/C/sub g.s./ reactions.

2285 (RCNP-P—97, pp 75-78) **Angular distribution of alpha-transfer reaction at forward angles.** Ogino, Koya. (Kyoto Univ. (Japan). Faculty of Engineering). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

Angular distribution of /sup 24/Mg(/sup 6/Li,d) reaction were measured at forward angles for study alpha-transfer reaction mechanism and alpha-cluster structure in Nuclei. The differential cross section at 54.9 MeV bombarding energy have sharply forward peak and the same patterns are also obtained in the case of 71.7 and 43.7 MeV bonbarding energies.

2286 **/sup 22/Na(n,p)/sup 22/Ne and /sup 22/Na(n,α)/sup 19/F cross sections from 25 meV to 35 keV.** Koehler, P.E.; O'Brien, H.A. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 5, 2019-2025(Nov 1988).

The /sup 22/Na(n,p_0), (n,p_1), (n,α_0), (n,α_1), and (n,α_2) cross sections have been measured at thermal neutron energy. ín addition, the p_0 and p_1 cross sections have been measured from thermal energy to 420 eV and 35 keV, respectively. These new data were used to discern the structure of /sup 23/Na near the neutron threshold. In particular, it was found that a $((7/2)^+$ resonance domi-

nates the p_1 cross section but contributes very little to the p_0 cross section. The p_0, and also most probably the (n,α_0) cross sections, are instead dominated by a separate $((5/2)^+$ resonance. The /sup 22/Na(n,p)/sup 22/Ne astrophysical reaction rate, N/sub A/ $<\sigma v>$, was calculated using our new data and compared to published theoretical rates used in previous nucleosynthesis calculations. It was found that the theoretical rates are approximately a factor of 5 to 10 different from the experimental one at most temperatures measured. We discuss the possible implications of this difference on nucleosynthesis calculations for /sup 22/Na and /sup 22/Ne.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

2287 (ORNL/TM—10841) **^{58}Ni + n transmission, differential elastic scattering and capture measurements and analysis from 5 to 813 keV.** Perey, C.M.; Perey, F.G.; Harvey, J.A.; Hill, N.W.; Larson, N.M.; Macklin, R.L. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 110p. (ENDF—347). NTIS, PC A06/MF A01. Order Number DE89001958/JAW.

High-resolution neutron measurements for ^{58}Ni-enriched targets were made at the Oak Ridge Electron Linear Accelerator (ORELA) from 100 eV to ~20 MeV in transmission, from 10 keV to 5 MeV in differential elastic, and from 2.5 keV to 5 MeV in capture. The transmission data were analyzed from 10 to 813 keV with the multilevel R-matrix code SAMMY which uses Bayes' theorem for the fitting process. This code provides energies and neutron widths of the resonances inside the 10- to 813-keV region as well as a possible parameterization for resonances external to that region to describe the smooth cross section from 10 to 813 keV. The differential elastic data at different scattering angles were compared to theoretical calculations from 30 to 813 keV using an R-matrix code based on the Blatt-Biedenharn formalism. Various combinations of spin and parity were tried to predict cross sections for the well defined {ell} > 0 resonances, and comparison with the data then provided spin and parity assignments for most of these resonances. the capture data were analyzed from 5 to 450 keV with a least-squares fitting code using the Breit-Wigner formula. In this energy region 30% more resonances were observed in the capture data than in the transmission data. 55 refs., 44 figs., 3 tabs.

2288 (RCNP-P—97, pp 98-102) **Significance of the experiment to search for the K = 0/sub 1//sup -/ band with the α + /sup 40/Ca structure in /sup 44/Ti.** Ohkubo, Shigeo. (Kochi Women's Univ. (Japan). Dept. of Applied Science). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

2289 (RCNP-P—97, pp 116-127) **On the incomplete fusion reaction mechanism and linear momentum transfer in heavy ion reactions.** Ohta, Masahisa; Okai, Sueji; Abe, Yasuhisa. (Konan Univ., Kobe (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

Through the analysis of the bidimensional mass spectrum of the evaporation residue in the /sup 40/Ar + /sup 68/Zn reaction (15 - 35 MeV/u) by means of the statistical evaporation model with temperature dependent separation energy of emitting nucleon, incomplete fusion reaction mechanisms are investigated on the view point of its Q-value. It is found that the large Q-value process corresponding to the Fermi-jet like one is favourable to reproduce the experimental data in comparison with the small Q-value process like cluster transfers. It is also confirmed that the maximum excitation energy deposited in the compound nucleus plays an important role on the linear momentum transfer and mass spectrum of evaporation residues at high incident energies.

2290 (RCNP-P—97, pp 134-137) **Relativistic effects on deuteron elastic scattering at intermediate energies.** Kameyama, H.; Yahiro, M. (Kyushu Univ., Fukuoka (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

Three-body dynamics of deuteron elastic scattering is described in relativistically covariant form to order 1/c/sup 2/. It has shown that for d + /sup 58/Ni scattering at 700 MeV the effect of Lorentz contraction is very small at the forwad angles and the Thomas-precession correction is appreciable for tensor analyzing powers at angles smaller than 25 deg where experimental data are available.

2291 **Energy dependence of the deformed optical potential for neutron scattering from /sup 54,56/Fe and /sup 58,60/Ni up to 80 MeV.** Pedroni, R.S.; Howell, C.R.; Honore, G.M.; Pfutzner, H.G.; Byrd, R.C.; Walter, R.L.; Delaroche, J.P. (Department of Physics, Duke University, Durham, North Carolina 27706). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 5, 2052-2062(Nov 1988).

Angular distributions of the analyzing power A/sub y/(θ) have been measured for neutron elastic scattering and for neutron inelastic scattering to the first 2_1^+ states of /sup 54,56/Fe and /sup 58.60/Ni at 10 MeV, and for /sup 54/Fe and /sup 58/Ni at 14 and 17 MeV. The differential cross sections $\sigma(\theta)$ for the same processes were measured at 17 MeV for /sup 54/Fe and /sup 58/Ni. These measurements have been combined with other measurements of $\sigma(\theta)$ and A/sub y/(θ) and also with total cross sections to form a sizable data set for incident neutron energies up to 80 MeV. This data set has been described in the context of the coupled channels formalism to determine the energy dependences of the various terms of the deformed optical potential. Some emphasis was placed on investigating the magnitude of the deformation parameter β/sub so/ of the neutron spin-orbit potential and the possibility that it might be energy dependent.

2292 **Comment on "Asymmetric fission of /sup 56/Ni".** Shapira, D. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **61**: No. 18, 2153-2153(31 Oct 1988).

A Comment on the Letter by S. Sanders et al., Phys. Rev. Lett. 59, 2856 (1987).

2293 **Sanders et al. reply.** Sanders, S.J.; Kovar, D.G.; Back, B.B.; Beck, C.; Dichter, B.K.; Henderson, D.; Janssens, R.V.F.; Keller, J.G.; Kaufman, S.; Wang, T.; and others. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **61**: No. 18, 2154-2154(31 Oct 1988).

Observation of asymmetric fission fragments from the fission of ^{56}Ni as populated in the ^{32}S + ^{24}Mg reaction have been interpretted in the standard fission model. This analysis can be extended to even lighter systems which have asymmetric yields. (AIP)

6516 Nuclear Properties And Reactions, A=59-89, Experimental

2294 (INIS-SU—68, pp 58) **Probabilities of K capture in /sup 67/Ga decay.** Begzhanov, R.B.; Azimov, K.Sh.; Il'khamdzhanov, N.A.; Magrupov, R.D.; Mirakhmedov, Sh.A.; Mukhammadiev, A.; Narzikulov, M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2295 (INIS-SU—68, pp 59-60) **Probabilities of the E2 γ-transitions in the /sup 70,72,74,76/Ge nuclei.** Dostemesova, G.A.; Kaipov, D.K.; Kosyak, Yu.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2296 (INIS-SU—68, pp 61) **New data on lifetimes of / sup 72/Ge nucleus levels.** Dostemesova, G.A.; Kaipov, D.K.; Kosyak, Yu.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/ JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2297 (INIS-SU—68, pp 62) **Properties of /sup 76/As excited states.** Fedorets, I.D.; Zalyubovskij, I.I.; Mishchenko, V.M.; Storizhko, V.E. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2298 (INIS-SU—68, pp 64) **Plunger measurements of lifetimes of /sup 79/Se energy levels.** Kudoyarov, M.F.; Kuz'min, E.V.; Pasternak, A.A.; Funke, L.; Dering, I.; Shvengner, R.; Vinter, D. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2299 (INIS-SU—68, pp 65) **Measurement of lifetimes of /sup 79/Se energy levels by DSA method.** Kudoyarov, M.F.; Kuz'min, E.V.; Pasternak, A.A.; Funke, L.; Dering, I.; Shvengner, R.; Vinter, D. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2300 (INIS-SU—68, pp 66-67) **Decay scheme of excited levels of /sup 85/Sr nuclei.** Zhovliev, U.J.; Zobov, A.E.; Pasternak, A.A.; Chugunov, I.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2301 (INIS-SU—68, pp 68) **Lifetimes of /sup 85/Sr energy levels determined by means of DSA method.** Zhovliev, U.J.; Kudoyarov, M.F.; Kul'dzhanov, I.K.; Mishin, A.S.; Muminov, A.I.; Pasternak, A.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2302 (INIS-SU—68, pp 69) **Description of positive parity collective states of /sup 85/Sr nucleus.** Dojnikov, D.N.; Pasternak, A.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/ JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2303 (INIS-SU—68, pp 70-71) **Angular distributions of /sup 85/Sr nucleus γ-rays.** Zhovliev, U.J.; Kudoyarov, M.F.; Mishin, A.S.; Pasternak, A.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2304 (INIS-SU—68, pp 72) **Angular distributions of γ-quanta in the /sup 76/Ge(/sup 13/C,3n)/sup 86/Sr reaction.** Zobov, A.E.; Lemberg, I.Kh.; Mishin, A.S.; Rassadin, L.A.; Chugunov, I.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2305 (INIS-SU—68, pp 73) **High excited states of /sup 86/Sr nucleus.** Zobov, A.E.; Mishin, A.S.; Rotter, Kh.; Vinter, G.; Prade, Kh. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/ JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2306 **(JINR-E—1-87-99) Nuclear effects in deep inelastic muon scattering on deuterium and iron targets.** Benvenuti, A.C.; Bollini, D.; Bruni, G. and others. (Bologna Univ. (Italy). Ist. di Fisica). (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 7p. NTIS (US Sales Only), PC A02/ MF A01. Order Number DE88704600/JAW.

Submitted to the journal Phys. Letters B.

New results are presented on nuclear effects in deep inelastic muon scattering on deuterium and iron targets at large four momentum transfer Q/sup 2/. The ratio F/sub 2//sup Fe/(x)/F/sub 2//sup D(sub 2/ (x) where x is the Bjorken scale variable measured in the kinematic range $0.06 \leqq x \leqq 0.70$, 14 GeV/sup 2/ $\leqq$ Q/sup 2/ $\leqq$ 70 GeV/sup 2/ is in good agreement with earlier measurements in the region of $x > 0.25$. At lower x, the structure function ratio exhibits an enhancement of $\sim$ 5%. 6 refs.; 4 figs.; 1 tab.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

2307 **(DOE/ER/40418—T1) Radioactive decay and nuclear structure studies: Progress report, October 1, 1987--September 30, 1988.** Walters, W.B. (Maryland Univ., College Park (USA). Dept. of Chemistry). 1988. Contract FG05-88ER40418. 60p. NTIS, PC A04/MF A01. Order Number DE89002255/JAW.

In this report, new results are reported for the structures of ^{145}Pr, ^{147}Pr, ^{145}La, ^{132}Sb, ^{129}Sb, ^{119}Te, and ^{124}Xe.

2308 (INIS-SU—68, pp 75) **Measurement of lifetimes of energy levels excited in the (α,2nγ) reaction.** Begzhanov, R.B.; Azimov, K.Sh.; Narzikulov, M.; Fajzullaev, U.I.; Khamidova, K.; Khodzhaev, M.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2309 (INIS-SU—68, pp 76) **Decay of /sup 93m/Tc.** Belyavenko, V.S.; Vishnevskij, I.N.; Zheltonozhskij, V.A.; Stepanenko, V.A.; Ukhin, M.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2310 (INIS-SU—68, pp 80) **Study on the internal conversion electrons from the /sup 103/Rh(n,γe) reaction.** Kondurov, I.A.; Loginov, Yu.E.; MakMagon, T.D.; Osuma, A.; Sushkov, P.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2311 (INIS-SU—68, pp 81) **Fast M1-transitions in odd-odd /sup 104/Ag nucleus.** Volkov, D.A.; Kovalenko, A.I.; Levon, A.I.; Mishin, A.S.; Pasternak, A.A.; Rassadin, L.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2312 (INIS-SU—68, pp 83) **Characteristics of E0-components of /sup 106m/Ag nucleus decay transitions.** Kartashov, V.M.; Oborovskij, A.I.; Troitskaya, A.G. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2313 (INIS-SU—68, pp 85) **Gamma rays of /sup 107/Cd from the /sup 107/Ag(p,nγ) reaction.** Vishnevskij, I.N.; Dej, Yu.A.; Kirichenko, M.Yu.; Malyuk, I.A.; Mel'nikov, O.B.; Tkachuk, I.P.; Trishin, V.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2314 (INIS-SU—68, pp 87) **Lifetimes of excited states of /sup 113/Sn nucleus.** Vishnevskij, I.N.; Kirichenko, M.Yu.; Kudoyarov, M.F.; Kuz'min, E.V.; Lobach, Yu.N.; Pasternak, A.A.; Trishin, V.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2315 (INIS-SU—68, pp 88-89) **Angular distribution of /sup 113/Sn γ-rays from the (α,nγ) reaction.** Vishnevskij, I.N.; Kirichenko, M.Yu.; Kudoyarov, M.F.; Kuz'min, E.V.; Lobach, Yu.N.; Pasternak, A.A.; Tkachuk, I.P.; Trishin, V.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2316 (INIS-SU—68, pp 91) **Population of high-spin states in /sup 113/Sb nucleus and description of aligned states in odd antimony isotopes.** Burminskij, V.P.; Dombrovskaya, G.S.; Kovrigin, O.D.; Zarifov, R.A.; Antsyferov, O.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2317 (INIS-SU—68, pp 93) **Probability of K capture in /sup 133/Ba decay.** Begzhanov, R.B.; Azimov, K.Sh.; Magrupov, R.D.; Mirakhmedov, Sh.A.; Mukhammadiev, A.; Narzikulov, M.; Salimov, S.Kh. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2318 (INIS-SU—68, pp 97-98) **Gamma radiation from the /sup 146/Eu decay.** Adam, I.; Zhelev, Zh.T.; Kratsik, B.; Tlusty, P. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2319 (JINR-R—3-88-67) **Study on the /sup 123/Te(n,α) reaction in 2 keV neutron energy region by means of double-grid ionization chamber.** Vertebnyj, V.P.; Grebnev, A.V.; Vtyurin, V.A.; Zhak, A.; Chadraabal, I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704639/JAW.

The /sup 123/Te(n,a) reaction has been investigated at E/sub n/=2keV neutron energy using the improved measuring technique. A double-girl ionization chamber is described. It has been constructed to study the (n,a) reaction and has provided by a factor of 1.5/sup -2/ lower background without reducing the spectrometer resolution. An upper limit for the total averaged (n,a) reaction cross section σ/sub n,σ/=1.4+-1.3 μb has been obtained. The Monte Carlo calculation within the statistical theory basing on the unknown parameters of neutron resonances and average alpha width within obtained earlier in the E/sub n/ < 2.5 keV region yielded the distribuiion function of the expected cross section value. From here the most probable value of 25 μb has been obtained, and the probability for experimental cross section was below 10/sup -4/. This result has revealed that the smallness of the cross section observed cannot be due to statistical fluctuation and points to the overestimated value of average alpha-width of /sup 123/Te in the calculations. 18 refs.; 7 figs.; 1 tab.

2320 (JINR-R—7-87-621) **Manifestation of shell structure in Zn+Sn reaction product characteristics.** Sodan, H.; Luk'yanov, S.M.; Penionzhkevich, Yu.Eh. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704647/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The results of measurements of dependences for reaction product yields on mass and total kinetic energy (TKE) for /sup 64/Zn induced reactions on the silver, tin, lantanum targets at the different beam energy over Coloumb barrier are presented. Considerable yields of projectile- and target-like products with TKE-values smaller than Coloumb barrier had been observed in the reactions with Sn-targets in contrast to the results for other targets. Observed shape peculiarities can be connected with initial structures of interacting nuclei, namely, with shell effect Z=50 of target, which provides conservation of individual properties of the target nuclei. 10 refs.; 7 figs.

2321 **Transfer reactions for the /sup 50/Ti + /sup 90/Zr system below the Coulomb barrier.** Kim, H.J.; Gomez del Campo, J.; Hindi, M.M.; Shapira, D.; Stelson, P.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2081-2085(Nov 1988).

The analysis of quasielastic cross section data for the /sup 90/Zr projectile plus /sup 50/Ti target system shows that the probability for /sup 50/Ti(/sup 90/Zr, /sup 49/Ti)/sup 91/Zr, 1n-transfer reaction near the barrier is much larger than estimates based on semiclassical theory. The probability for /sup 50/Ti(/sup 90/Zr,/sup 51/V)/sup 89/Y, 1p-transfer reaction, on the other hand, agrees with the same theory. The internuclear distance where the 1n-transfer probability first deviates from tunneling predictions coincides with the threshold of the fusion barrier distribution deduced from the experimental fusion cross sections of the /sup 50/Ti+/sup 90/Zr system, suggesting a common mechanism for the large enhancement of 1n-transfer and fusion cross sections.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

2322 (INIS-SU—68, pp 106) **On the energy of /sup 153/Gd electron capture.** Gavrilyuk, V.I.; Kirishchuk, V.I.; Lashko, A.P.; Stril'chuk, N.V.; Feoktistov, A.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2323 **(JINR-E—3-87-536) On the influence of the final states structure on the intensity of two-quanta cascades.** Boneva, S.T.; Khitrov, V.A.; Popov, Yu.P.; Sukhovoj, A.M.; Vasil'eva, E.V.; Yazvitskij, Yu.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704612/JAW.

Submitted to the 6th Symposium on Capture Gamma-Ray Spectroscopy and Related Topics, Belgium, 1987.

The dependence of two-quanta intensities of gamma-cascades on the structure of their final level in compound /sup 175/Yb, /sup 179/Hf and /sup 168/Er, /sup 178/Hf nuclei is found. The experiment is performed by the method of summation of amplitudes of coinciding pulses of two Ge(Li)-detectors. The dependence of two-cascades intensity on the structure of final level in /sup 175/Yb and /sup 179/Hf is connected with the effect of quantum number K on partial widths of secondary cascade transitions and in /sup 169/Er and /sup 178/Hf, with the structure of final single-phonon cascade states. 4 refs.; 1 tab.

2324 **(JINR-R—1-87-905) Momentum and angular characteristics of protons produced in dTa and CTa interactions at 4.2 GeV/c per nucleon.** Armutlijski, D.; Gasparyan, A.P.; Grishin, V.G. and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704626/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Momentum and angular characteristics of protons produced in the collision of deuterium and carbon nuclei with tantalum nuclei at 4.2 GeV/c per nucleon have been investigated. It is shown that the experimental data are satisfactorily described by a Dubna version of the cascade-evaporation model (DCM). 9 refs.; 7 figs.; 6 tabs.

2325 **Limits on P- and P,T-violating absorption of MeV neutrons in /sup 165/Ho.** Soderstrum, J.P.; Gould, C.R.; Haase, D.G.; Seagondollar, L.W.; Schneider, M.B.; Roberson, N.R. (North Carolina State University, Raleigh, North Carolina 27695). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2424-2426(Nov 1988).

We have searched for enhancements of parity violation and combined parity and time reversal violation in the scattering of MeV neutrons from holmium. P-violating analyzing powers, measured by transmission of longitudinally polarized neutrons through unpolarized holmium, were consistent with zero: rho/sub P/ = (-2.4 +- 2.6) x 10/sup -4/ at 7.4 MeV and (-0.2 +- 1.9) x 10/sup -4/ at 12.4 MeV. P,T-violating analyzing powers, measured by transmission of vertically polarized neutrons through horizontally polarized holmium, were also consistent with zero: rho/sub P//sub ,// sub T/ = (-0.9 +- 2.0) x 10/sup -3/ at 7.1 MeV and (-0.4 +- 2.9) x 10/sup -3/ at 11.0 MeV.

2326 **Usual rotational behavior in /sup 178/Os.** Burde, J.; Macchiavelli, A.O.; Deleplanque, M.A.; Diamond, R.M.; Stephens, F.S.; Beausang, C.W.; McDonald, R.J.; Draper, J.E. (Lawrence Berkeley Laboratory, Nuclear Science Division, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2470-2473(Nov 1988).

A very unusual rotational band has been found in /sup 178/Os. It consists of seven regularly spaced transitions about 36 keV apart, which corresponds closely to that of the superdeformed band in /sup 152/Dy after an A/sup 5/3/ normalization. This band populates the yrast band directly, thus permitting rather reliable spin assignments. Based on these, the moment of inertia J/sup (1)/ is found to be much smaller than the J/sup (2)/ derived from the above γ-ray spacings. The most likely interpretation of this is a band with large deformation which is undergoing systematic changes in deformation, pairing, and/or alignment.

2327 **Evidence for a low-frequency πh/sub 9/2/ band crossing in /sup 185/Pt and /sup 183/Ir.** Janzen, V.P.; Carpenter, M.P.; Riedinger, L.L.; Schmitz, W.; Pilotte, S.; Monaro, S.; Rajnauth, D.D.; Johansson, J.K.; Popescu, D.G.; Waddington, J.C.; and others. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996-1200). *Physical Review Letters;* **61**: No. 18, 2073-2076(31 Oct 1988).

Evidence is presented for a πh/sub 9/2/ band crossing at surprisingly low rotational frequency in the odd-neutron /sup 185/Pt and odd-proton /sup 183/Ir nuclei. The proton nature of the crossing is indicated by measured B(M1;I→I-1)/B(E2;I→I-2) ratios, strongly supported by theoretical values from both the semiclassical Doenau and Frauendorf approach and a variable-core particle-rotor calculation employing cranked-shell-model matrix elements. However, the actual crossing frequency is greatly overestimated by the cranking method using generally accepted model parameters.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

2328 **Electromagnetic spallation of 6.4-TeV /sup 32/S nuclei.** Price, P.B.; Ren Guoxiao; Williams, W.T. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 19, 2193-2196(7 Nov 1988).

We have studied the fragmentation of 6.4-TeV /sup 32/S nuclei in Pb, Cu, and Al targets. For Pb, the electromagnetic spallation cross sections are larger than the nuclear cross sections. For Pb and Cu the electromagnetic spallation cross sections decrease with projectile charge loss ΔZ as $\sim\exp(-0.6\Delta Z)$ and show a dependence on target charge consistent with $\sim$Z/sub T//sup 1.8/ as predicted by theory.

2329 **Total projectile kinetic energy scaling in energetic nucleus-nucleus collisions.** Loveland, W.; Xu, Z.; Casey, C.; Aleklett, K.; Liljenzin, J.O.; Lee, D.; Seaborg, G.T. (Department of Chemistry, Oregon State University, Corvallis, Oregon 97331). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2094-2100(Nov 1988).

The target fragment production cross sections have been measured for the reaction of 150 MeV/nucleon /sup 139/La with /sup 197/Au. From these cross sections, the fragment isobaric yields were deduced. The resulting isobaric yield distribution is very similar to that observed for reactions in which limiting fragmentation is occurring (such as the reaction of 8 GeV /sup 20/Ne with /sup 197/Au) and unlike that observed with projectiles of similar velocity. This apparent extreme example of total projectile kinetic energy scaling is compared to predictions of the intranuclear cascade model.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

2330 **(DOE/ER/40255—3) A study of high energy nucleus-nucleus interactions: CERN experiment NA38: Final report.** (City Univ. of New York, NY (USA). Research Foundation). 19 Oct 1988. Contract AC02-86ER40255. 6p. NTIS, PC A02/MF A01. Order Number DE89001976/JAW.

This research, which is still in progress, and in which the author continues to participate in the absence of further DOE support, consists of a study of interactions between O{sup 16} and S{sup 32} ions and copper and uranium nucleii performed at the CERN SPS, and using the existing NA10 dimuon spectrometer enhanced by an upstream electromagnetic calorimeter an active target assembly, and beam hodoscopes. The strategy of the experiment has been described in the proposals of the present contract, and the rest of this report will be confined to a summary of the preliminary results obtained. 3 refs., 2 figs.

2331 (IAEA-TECDOC—469, pp 57-66) **Systematics of transuranium nuclei fission cross-sections.** Fursov, B.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

The paper presents the principles of constructing the systematics of transuranium nuclei fission probability characteristics based on the current model of fission barrier and statistical approach. Fission probability energy dependence was investigated. The results of systematics were shown in comparison with the experimental data. (author). 24 refs, 12 figs.

2332 **(IKDA—87/35) New experimental insights into the nuclear fission reaction.** Theobald, J.P. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Kernphysik). Nov 1987. 11p. (CONF-8711237—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755283/JAW.

From 17. international symposium on nuclear physics - nuclear reactions; Gaussig, German D.R. (9 Nov 1987).

Experimental results on cold-deformed fragmentation, spontaneous nuclear tripartition, alpha particle associated nuclear fission and on fission fragment kinetic energy fluctuations in resolved neutron resonances are presented and discussed.

2333 **(JINR-E—7-87-167) Synthesis and study of atomic nuclei with Z>100.** Flerov, G.N.; Ter-Akopyan, G.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704621/JAW.

Submitted to the journal Progress Part. Nucl. Phys. .

The studies of atomic nuclei with Z>100 are closely related to the synthesis of new chemical elements and to the investigation of stability limits for the heaviest nuclides. From the mid-50s these studies have been carried out using intense heavy-ion beams and highly sensitive techniques designed for the physical and chemical identification of rare short-lived nuclei. The studies proceeded in two stages, the first one being characterized by the use of hot-fusion reactions between the U, Pu, Am, Cm and Cf target nuclei and the C, N, O, and Ne projectiles and the second being based on the use of the cold-fusion reactions induced by Cr, Mn, and Fe projectiles on Pb and Bi target nuclei. As a result, the chemical elements with atomic numbers from 102 to 109 have first been synthesized. The radioactive properties of over 40 isotopes of these elements have been investigated and unambigous evidence has been obtained that shell effects play a decisive role for the stability of the Z>or approx.104 nuclei against spontaneous fission. This provides an experimental substantiationfor the known hypothesis that the island of nuclear stability should lie around Z~114 and N~178 or 184. It has been proposed to synthesize elements with Z≧110 by complete fusion reactions of uranium and adjacent element nuclei with projectile nuclei such as Ar and Ca. The spontaneous fission of a product nucleus (a total of 26 events) has been observed in Dubna experiments with the /sup 232/Th+/sup 44/Ca and /sup 236/U+/sup 40/Ar reactions. The authors of those studies tentatively assigned this activity to the decay of the nuclei of element 110. 150 refs.; 9 figs.; 5 tabs.

2334 **(LBL—24495) Complex fragments from excited actinide nuclei: A new test of the finite range model.** Sarantities, D.G.; Bowman, D.R.; Wozniak, G.J.; Charity, R.J.; Liu, Z.H.; McDonald, R.J.; McMahan, M.A.; Moretto, L.G. (Lawrence Berkeley Lab., CA (USA); Washington Univ., St. Louis, MO (USA). Dept. of Chemistry). May 1988. Contract AC03-76SF00098. 11p. NTIS, PC A03/MF A01. Order Number DE89002014/JAW.

Complex fragments ranging in charge from 7≦Z≦45 have been detected in binary coincidence following the reaction of 8.4 MeV/u ^{232}Th+ ^{12}C, and are shown to arise from the binary decay of a ^{244}Cm compound nucleus. This work confirms earlier radiochemical observations of very light fragments in the fission fragment mass distribution, establishes their binary character, and interprets their yield in terms of finite range potential energy barriers. 15 refs., 3 figs.

2335 **Fertile-to-fissile and fission measurements for depleted uranium and thorium bombarded by 800-MeV protons.** Gilmore, J.S.; Russell, G.J.; Robinson, H.; Prael, R.E. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM (US)). *Nuclear Science and Engineering;* **99**: No. 1, 41-52(May 1988).

Axial distributions of fissions and of fertile-to-fissile conversions in thick depleted uranium and thorium targets bombarded by 800-MeV protons have been measured. The amounts of /sup 239/Pu and /sup 233/U produced were determined by measuring the yields of /sup 239/Np and /sup 233/Pa, respectively. The number of fissions was deduced from fission product mass-yield curves. Integration of the axial distributions gave the total number of conversions and fissions occurring in the targets. For the uranium target, experimental results were 5.90 +- 0.25 fissions and 3.81 +- 0.01 atoms of /sup 239/Pu produced per incident portion. Corresponding calculated results were 6.14 +- 0.04 and 3.88 +- 0.03. In the thorium target, 1.56 +- 0.25 fissions and 1.25 +- 0.01 atoms of /sup 233/U per incident proton were measured; the calculated values were 1.54 +- 0.01 fissions and 1.27 +- 0.01 atom/proton.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 2165, 2183, 2192, 2241, 2325, 2331, 2334, 2429

2336 **(DOE/ER/40388—1) Research in theoretical nuclear physics: Progress report.** (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Aug 1988. Contract FG02-88ER40388. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88016482/JAW.

In April 1988 we, along with the nuclear theory groups of Brookhaven and MIT, submitted a proposal to the Department of Energy for a national Institute of Theoretical Nuclear Physics. The primary areas of investigation proposed for this Institute are: Strong Interaction Physics--including (!) The physics of hadrons, (2) QCD and the nucleus, (3) QCD at finite temperatures and high density; nuclear astrophysics; nuclear structure and nuclear many-body theory; and nuclear tests of fundamental interactions. It is, of course, no coincidence that these are the main areas of activity of the three groups involved in this proposal and of our group in particular. Here, we will organize an outline of the progress made at Stony Brook during the past year along these lines. These four areas do not cover all of the activities of our group.

2337 **(EFI—962(12)-87) Estimate of contribution of secondary intranuclear processes to production of cumulative protons in π/sup -/C interactions at 5 GeV/c.** Gulkanyan, G.R.; Asaturyan, V.M.; Khudaverdyan, A.G. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 21p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704420/JAW.

The contribution of possible intranuclear secondary processes (interactions of secondary mesons with nucleons and few-nucleon systems; interactions of Δ-resonances with nuclear nucleons) to the production of cumulative protons in π/sup -/C interactions at 5 GeV/c is investigated. It is obtained that the contribution of secondary processes makes approximately half of the inclusive cross section of cumulative protons with momenta P/sub P/ ≦ 0.75 GeV/c.

2338 (IAEA-TECDOC—469, pp 10-15) **Coupled channel method for calculation of neutron cross-sections.** Ignatyuk, A.V.; Lunev, V.P.; Pronyaev, V.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

The basic concept of the couple-channel optical model used for the calculation of neutron cross sections is described. As typical examples, the results of the differential elastic and inelastic scattering for /sup 52/Cr and the total neutron cross sections for /sup 56/

Fe, /sup 208/Pb calculated by the channel method are given. (author). 16 refs, 6 figs.

2339 (IAEA-TECDOC—469, pp 16-22) **Theoretical analysis and systematics of threshold reaction cross-sections.** Bychkov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

Theoretical analysis of nuclear reaction cross sections is often used in nuclear data. In this survey, the theoretical description (including direct, pre-equilibrium and equilibrium contributions) of neutron threshold reactions in the energy region up to 20 MeV, the dependence of the results on the parameters used in calculations and the systematical trends of the cross-section dependence from the neutron and proton number in the target nucleus were discussed. (author). 12 refs, 3 figs.

2340 (IAEA-TECDOC—469, pp 48-57) **Nuclear data measurement.** Kornilov, N.V.; Piksajkin, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

Precision neutron flux measurement is one of the most important requirements in nuclear data measurements. The paper concentrates on questions to do with measuring neutron flux and determining the various corrections, using the H(n,n), /sup 235/U(n,f), / sup 238/U(n,f), /sup 27/Al(n,α) and /sup 197/Au(n,γ) standard nuclear reactions as examples. (author). 29 refs, 6 figs.

2341 (IAEA-TECDOC—469, pp 95-100) **Neutron yield from reactions produced by alpha particles with energies up to 10 MeV.** Vukolov, V.A.; Chukreev, F.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

Basing on the estimated values of the cross sections of the (a,n) reactions for lithium, beryllium, boron, carbon, fluorine and oxygen the neutron yields have been calculated for targets prepared of these materials. The yields for chemical compounds of actinides with light nuclei have been also calculated. The general approach in performing such calculations with charged particles and the evaluation method are discussed. (author). 20 refs, 1 fig., 2 tabs.

2342 (IAEA-TECDOC—469, pp 33-39) **Fission cross-section calculation.** Egorov, S.A.; Rubchenya, V.A. (Radievyj Inst., Leningrad (USSR)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

A method based on the statistical Hauser-Feshbach theory for the calculation of fission cross sections was described. The main values, the level densities and the transmission coefficients in the different reaction channels are discussed in detail. As an example, the results of Cm(n,f) reaction calculations are presented. (author). 25 refs, 8 figs, 2 tabs.

2343 (IAEA-TECDOC—469, pp 128-142) **Application of covariances in the evaluation of dosimetry reaction excitation functions.** Tagesen, S. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

Application of the least squares method to the evaluations of excitation functions is considered for the cases of absolute, ratio and shape measurements. Updating of existing evaluations because of new measurement results is also described. A practical example for demonstration is given. (author). 12 refs, 5 figs.

2344 **(INIS-GB—82) Nuclear structure. Appendix to the Daresbury annual report 1985/86.** Eastham, D.A.; Joy, T. (comps.). (Daresbury Lab. (UK)). 1986. 117p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780102/JAW.

The paper on 'nuclear structure' is the Appendix to the Daresbury (United Kingdom) Annual Report 1985/86, and contains the research work carried out at the Nuclear Structure Facility, Daresbury, within that period. During the year a total of 74 experiments were scheduled covering the main areas of activity including: nuclear collective motion, nuclei far from stability, and nuclear collisions. The Appendix contains brief reports on these experiments and associated theory. (U.K.).

2345 (INIS-mf—11319, pp 46) **New effective interactions for Of-1p nuclei.** Richter, W.A.; Van der Merwe, M.G.; Julies, R.E.; Brown, B.A. (Stellenbosch Univ. (South Africa); University of the Western Cape, Bellville (South Africa); Michigan State Univ., East Lansing (USA). Cyclotron Lab.). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2346 (INIS-mf—11319, pp 62) **Reactions in silicon detectors induced by neutrons.** Prozesky, V.M.; Mingay, D.W. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2347 (INIS-SU—68, pp 52) **New deformation range of neutron-rich nuclei and emission of delayed neutrons.** Zverev, M.V.; Lyutostanskij, Yu.S.; Panov, I.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2348 (INIS-SU—68, pp 77) **Reasons of appearence of structure in radiative properties of energy levels of even-even nuclei with A=96-154.** Demidov, A.M.; Govor, L.I.; Mikhajlov, I.V. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2349 (INIS-SU—68, pp 79) **Forbidden numbers of nucleons in atomic nucleus.** Burmistrov, V.R. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2350 (INIS-SU—68, pp 84) **High spin states in /sup 106/Cd and /sup 108/Cd nuclei.** Sychikov, G.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2351 (INIS-SU—68, pp 86) **Empiric formula for binding energy of nuclei with A>100.** Solin, L.M.; Kuz'min, V.N.; Kalinin, V.A.; Nemilov, Yu.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2352 (INIS-SU—68, pp 95) **Role of quasiparticle configurations in enhancement of gamma transitions in the /sup 143/Nd(n,γ) reaction with averaging on resonances.** Knat'ko, V.A.; Shimanovich, E.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2353 (INIS-SU—68, pp 101) **Improvement of empiric dependence of the binding energy on N-Z.** Solin, L.M.; Kuz'min, V.N.; Kalinin, V.A.; Nemilov, Yu.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2354 (INIS-SU—68, pp 102) **Determination of proton pairing energies in the range of A=150-180 from empiric regularities for binding energy.** Solin, L.M.; Kuz'min, V.N.; Kalinin, V.A.; Nemilov, Yu.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2355 (INIS-SU—68, pp 105) **Isomeric /sup 152m/Eu(0/sup -/)->/sup 152g/Eu(3/sup -/) M3 transition.** Babenkov, M.I.; Bobykin, B.V.; Zhdanov, V.S.; Starodubov, S.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2356 (INIS-SU—68, pp 118) **Pseudorotational transitions.** Dzhelepov, B.S. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2357 (INIS-SU—68, pp 96) **Spectroscopic possibilities of the coinciding pulse amplitude summation method in radiative neutron capture.** Boneva, S.T.; Vasil'eva, Eh.V.; Popov, Yu.P.; Sukhovoj, A.M.; Khitrov, V.A. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2358 (INIS-SU—68, pp 78) **Structure of the energy levels of /sup 97/Ru and /sup 101/Ru nuclei.** Begzhanov, R.B.; Khodzhaev, M.M. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2359 (INIS-SU—68, pp 90) **Energy and periods of α and β decay of nuclei in region from Sn to Pb.** Kolesnikov, N.N. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2360 (INIS-SU—68, pp 104) **Confirming K963 keV shift effect existence in the /sup 152m/Eu decay.** Bulgakov, V.V.; Kupryashkin, V.T.; Lashko, A.P.; Stril'chuk, N.V.; Feoktistov, A.I. 1988. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780021/JAW. (CONF-8804216—).

From 38. All-Union conference on nuclear spectroscopy and nuclear structure; Baku, USSR (12 Apr 1988).

2361 **(JINR-E—4-87-366) New aspects of the interacting boson model.** Nadzakov, E.G.; Mikhajlov, I.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704613/JAW.

Submitted to the journal Izv. AN SSSR, Ser. Fiz. .

In the framework of the boson space extension called interacting multiboson model: conserving the model basic dynamic symmetries, the s p d f boson model is considered. It does not destruct the intermediate mass nuclei simple description, and at the same time includes the number of levels and transitions, inaccessible to the usual s d boson model. Its applicability, even in a brief version, to the recently observed asymmetric nuclear shape effect in the Ra-Th-U region (and in other regions) with possible octupole and dipole deformation is demonstrated. It is done by reproducing algebraically the yrast lines of nuclei with vibrational, transitional and rotational spectra. 70 refs.; 3 figs.

2362 **(JINR-E—4-87-492) On the role of hexadecapole forces in describing γ-band states in the rare-earth region.** Nesterenko, V.O.; Kukhtina, I.N.; Sushkov, A.V.; Dao Tien Khoa. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704614/JAW.

Submitted to the journal J. Phys., G.

Calculations are made for the isoscalar transition rates B(IS2, gr.->2/sup +/2γ) and B(IS4, gr.->4/sup +/2γ) in the random phase approximation with a common system of equations for hexadecupole interactions λ/sub μ/=22 and 42, and for the inelastic form factors in the folding model. The analysing powers and cross sections in the (p-bar, p/sup '/) reaction with E/sub p/65 MeV are calculated within the coupled-channel method by using the microscopic form factors for the levels 2/sup +/2γ and 4/sup +/2γ in /sup 168/Er. It is shown that extremely large values of B(IS4, gr.->4/sup +/2γ) obtained in the (p-bar, p/sup '/) and (α, α/sup '/) reactions are mostly due to the contribution of indirect excitation channels but not to a strong hexadecapole interaction λ/sub μ/=42. A moderate value of the hexadecapole interaction constant κ/sub 0//sup (42)/=0.012 fm/sup 2//MeV provides a satisfactory description of the available experimental data. 20 refs.; 3 figs.

2363 **(JINR-E—4-87-745) Dynamical inequivalence of the structure of the collective subspace in the fermion and boson representations.** Kuchta, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704615/JAW.

Submitted to the journal Z. Phys., A.

An exact boson mapping of the multi-shell pairing-plus-quadrupole Hamiltonian onto a Hermitian boson image with at most two-body terms is performed. The resulting boson Hamiltonian truncated to s- and d-boson is shown to be capable of decribing the exact energy spectrum and electromagnetic transition rates better than the original fermion Hamiltonian restricted to the space of S- and D-pairs. This situation persists within the sdg-SDG truncation as well. It can thus be concluded that the boson and fermion subplaces with the same multipole structure are dynamically inequivalent. 17 refs.; 2 figs.

2364 **(JINR-E—4-87-795) On collective two-phonon states in deformed nuclei.** Solov'ev, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704616/JAW.

Submitted to the journal Romanian J. Phys. .

Theoretical methods for describing two-phonon collective states in deformed nuclei are treated. The analysis of the experimental data indicates that collective two-phonon states have not yet been determined experimentally. Whether collective two-phonon states exist or not is stated to be the central problem for understanding the structure of excited states. The necessity for searching two-phonon states is pointed out. 28 refs.

2365 **(JINR-E—4-87-831) Effect of the particle-particle interaction on the Gamow-Teller β/sup +/-decay in spherical nuclei.** Kuz'min, V.A.; Solov'ev, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704618/JAW.

Submitted to the journal JETP Lett. .

In RPA approximation, taking account of residual separable interactions in the particle-hole and particle particle channels, ft-values for the Gamow-Teller β/sup +/-decays of /sup 152/Yb, /sup 150/Er, /sup 148,146/Dy and /sup 96/Pd are calculated. At a fixed constant ratio of the particle-particle and particle-hole interactions agreement with experimentally determined ft-values for chemical bondG/sub A//G/sub V/chemical bond=1 is obtained. It is shown that from the calculation of probabilities of β-decays of nuclei far from stability one cannot conclude on the renormalization of the axial-vector constant G/sub A/ of the weak interaction. 11 refs.; 1 tab.

2366 **(JINR-R—2-87-466) On a present status of the gathering model for cumulative meson production.** Ameev, S.Sh.; Golubyatnikova, E.S.; Shakhanova, G.A.; Shmonin, V.L.; Kalinkin, B.N. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704629/JAW.

Submitted to the journal Z. Phys., A.

Physical foundations of the "gathering" model are discussed. It is shown that the "gathering" of nucleons in a collective interaction is a direct consequence of the modern notions on the behaviour of colour forces at large distances. An analytical variant of the model is presented which allows us to much simplify the calculation procedure. The results obtained are compared with the data on cumulative π- and K-meson production. Specific features of the model application for relativistic nucleus-nucleus interactions are discussed. 27 refs.; 12 figs.

2367 **(JINR-R—2-87-672) On interpretation of cumulative processes in the collection model.** Tarasov, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704630/JAW.

Submitted to the journal Acta Phys. Polonica.

Papers of B.N.Kalinkin, V.L.Shmonin et al. describing cumulative meson production in hadron-nucleus and nucleus-nucleus interactions have been analyzed, and the results of this critical analysis are given. It is shown that there are many errors in the calculation formulae. The attempts to reproduce the numerical reuslts of the authors by their formulae and their computer program gave no positive results. 15 refs.; 3 figs.

2368 **(JINR-R—4-87-700) Semimicroscopic description of neutron inelastic scattering on intermediate mass nuclei.** Ivanova, S.P.; Kabesas, R.; Pedrosa, R.; Ponomarev, V.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704640/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

An approach to quasiparticle-phonon model (QPM) of nucleus semimicroscopic description of neutron inelastic scattering in spherical nuclei is developed. The interaction potential between neutron-nucleus is derived from the effective nucelon-nucleon interaction and transition nuclear densities. The direct and compound elastic and inelastic cross sections at energies from 1.5 to 3.0 MeV on /sup 58/Ni have been calculated in agreement with experimental data. 22 refs.; 4 figs.; 2 tabs.

2369 **(JINR-R—4-87-752) Microscopic calculation of / sup 4/H system with a realistic NN interaction.** Gorbatov, A.M.; Bursak, A.V.; Kolganova, E.A. and others. (Kalininskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 22p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704641/JAW.

Submitted to the journal Nucl. Phys., A.

Microscopic calculation of the spectrum /sup 4/H system with realistic NN-interaction by angular potential function method have been performed. Theoretical calculations of /sup 4/H levels are in good agreement with experimental data. Quasistationary states of the /sup 4/H system have anomalous large radii. 21 refs.; 7 figs.; 7 tabs.

2370 **(JINR-R—4-87-915) Dynamical SU(m)-symmetric and SU(m/n)-supersymmetric limits of the quasiparticle-phonon nuclear model.** Nguen Din' Dang. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704644/JAW.

Submitted to the journal Modern Physics Lettters, A.

The SU(m)-symmetric limit for even-even spherical nuclei and the SU(m/n)-supersymmetric limit for even-odd spherical nuclei of the quasiparticle-phonon nuclear model (QMP) are constructed. The generators of the graded superalgebra SU(m/n) and their matrix representation are constructed from the QPM operators in its SU(m/n) limit. The generalized Dyson realization for the QPM operators in this limit is obtained. Microscopic expressions for the parameters of the boson-fermion part in the hamiltonian of the Interacting Boson-Fermion Model are derived. 17 refs.

2371 **(LA-UR—88-3319) Preliminary calculations of medium-energy fission cross sections and spectra.** Bozoian, M.; Arthur, E.D.; George, D.C.; Madland, D.G.; Young, P.G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-8804213—1). NTIS, PC A02/MF A01. Order Number DE89002048/JAW.

From American Nuclear Society conference on fifty years with nuclear fission; Gaithersburg, MD, USA (26 Apr 1988).

Nucleon-induced fission cross sections determined from a statistical preequilibrium model are used in conjunction with a new scission-point model of fission fragment mass, charge and excitation energy distributions to produce evaporation model calculations of particle and gamma spectra and multiplicities from fission. Comparisons are made to experiment for the 14.5-MeV neutron-induced fission of ^{238}U. In addition, calculated particle and gamma spectra will be compared with the ENDF/B library for 2- and 5-MeV neutron-induced fission of ^{235}U and ^{238}U, respectively. Initial predictions for these same quantities for proton-induced fission reactions at energies up to 100 MeV will be presented and discussed. 6 refs., 3 figs.

2372 **(LA-UR—88-3358) Cold moderator scattering kernels.** MacFarlane, R.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 25p. (CONF-8810182—4). NTIS, PC A03/MF A01. Order Number DE89002038/JAW.

From International collaboration on advanced neutron sources; Los Alamos, NM, USA (3 Oct 1988).

New thermal scattering law files in ENDF format have been developed for solid methane, liquid methane, liquid ortho and para hydrogen, and liquid ortho and para deuterium using up-to-date models that include such effects as incoherent elastic scattering in the solid, diffusion and hindered vibration and rotations in the liquids, and spin correlations for the hydrogen and deuterium. These files were generated with the new LEAPR module of the Njoy Nuclear Data Processing System, and other modules of this system were used to produce cross sections for these moderators in the correct format for the continuous-energy Monte Carlo code MCNP being used for cold moderator design calculations at the Los Alamos Neutron Scattering Center LANSCE. 19 refs., 10 figs.

2373 **(LAFI—117) Binding energies and level schemes of heavy nuclei in the simplified strictly restricted dynamics model.** Sabaliauskas, L.; Vanagas, V.; Guseva, T.; Ruza, J.; Tambergs, J. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704667/JAW.

A simplified model with strongly restricted dynamics, effective quadrupole central interaction potential, and constant vectorial interaction and Coulomb interaction is described in detail. The application of the model for the binding energies and some excited level bands of heavy even-even and odd nuclei in 158 ≦ A ≦ 196 region have been qualitatively studied. 33 refs.; 3 figs.; 6 tabs.

2374 **(N—88-24251) Evaluation of energy-independent heavy ion transport coefficient approximations.** Townsend, L.W.; Wilson, J.W. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). 1988. 13p. (NASA-TM—101158; NAS—1.15:101158). NTIS, PC A03/MF A01.

Utilizing a one-dimensional transport theory for heavy ion propagation, evaluations of typical energy-dependent transport coefficient approximations are made by comparing theoretical depth-dose predictions to published experimental values for incident 670 MeV/nucleon Ne-20 beams in water. Results are presented for cases where the input nuclear absorption cross sections, or input fragmentation parameters, or both, are fixed. The lack of fragment charge and mass concentration resulting from the use of Silberberg-Tsao fragmentation parameters continues to be the main source of disagreement between theory and experiment.

2375 **(N—88-26935) Nucleon-nucleus interaction data base: Total nuclear and absorption cross sections.** Wilson, J.W.; Townsend, L.W.; Buck, W.W.; Chun, S.Y.; Hong, B.S.; Lamkin, S.L. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Aug 1988. 26p. (NASA-TM—4053; L—16461; NAS—1.15:4053). NTIS, PC A03/MF A01.

Neutron total cross sections are represented for Li to Pu targets at energies above 0.1 MeV and less than 100 MeV using a modified nuclear Ramsauer formalism. The formalism is derived for energies above 100 MeV by fitting theoretical cross sections. Neutron absorption cross sections are represented by analytic expressions of similar form, but shape resonance phenomena of the Ramsauer effect is not present. Elastic differential cross sections are given as a renormalized impulse approximation. These cross section data bases are useful for nucleon transport applications.

2376 (RCNP-P—96, pp 7-11) **On the three-body (cluster) force of /sup 12/C-nucleus.** Oryu, Shinsho; Kamada, Hiroyuki. (Science Univ. of Tokyo, Noda, Chiba (Japan). Faculty of Science and Technology). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

The 3α model of the /sup 12/C-nucleus is investigated by using the 3-body Faddeev equations with the Pauli-correct separable α-α potential. We obtained almost all of the low-lying energy spectra of the /sup 12/C-nucleus, however the shell-like states are over binding. It is saggested that the three-body force is important to represent the cluster-like states, the shell-like states and the negative parity states consistently. It is found that the symmetric Gaussian type three-body force is useful to obtain the good sequence of all the spectra, but is less effective to improve the wave functions. Moreover, a polarized three-body force is investigated, however, it is not suitable to obtain good energy spectra.

2377 (RCNP-P—96, pp 12-15) **Calculation of cluster expansion method.** Sakai, W. (Akashi Technical Coll., Hyogo (Japan)). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

The energies of low states of /sup 6/Li and /sup 5/He by one boson exchange force are calculated by the cluster expansion method (Factorized Iwamoto Yamada method). The importance of the three body calculation is shown by its role to confirm the truth of two body calculation. Then, the conclusion only two body calculation may not be justified. The model employed is α cluster model.

2378 (RCNP-P—96, pp 39-44) **Multi three-cluster coupling effects in d-α elastic scattering at E/sub d/ = 56 MeV.** Miyagawa, K. (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

This report shows the Multi Three-Cluster Coupling (MTCC) model calculation of d-α elastic scattering at E/sub d/ = 56 MeV. So far, any approach without adjustment parameters has not reproduced d-α elastic scatterings at E/sub d/ > 20 MeV, being contrary to the success below 20 MeV. We consider it due to the lack of the important process n + p + α -> n + d + /sup 3/He above 20 MeV. The MTCC, one of the connected-kernel approaches, can treat explicitly this three-cluster coupling. The MTCC calculation induces angular-distribution oscillation which is characteristic in analyzing power data at 56 MeV.

2379 (RCNP-P—96, pp 45-47) **Rearranged coupled-channel study for 3-, 4-body system.** Kameyama, Hirofumi; Kamimura, Masayasu; Fukushima, Yoshihiro. (Kyushu Univ., Fukuoka (Japan). Faculty of Science). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

2380 (RCNP-P—96, pp 54-62) **On a model-space solution of a three-body Lippmann-Schwinger equation in the absence of rearrangement channels.** Sawada, T. (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

There are two topics in this talk, both related to the non-uniqueness problem of a single three-body Lippmann-Schwinger (LS) equation. First, we discuss the results of a numerical investigation on a possible model-space dependence of a model-space solution to the LS equation obtained by a fictitious deuteron + nucleus scattering. In this calculation, real potentials of surface delta forms are utilized for nucleon-nucleus interactions, and no bin-averaging procedure of the CDCC approach is employed. The resulting elastic and breakup t-matrix elements show rapid convergence regardless of the presence of absence of rearrangement channels. They show no sign of suspected sustained dependence on the model space. Thus, although the model-space solution lacks rearrangement components in the asymptotic region, it appears to be truely unique. The conclusion drawn is quite general despite the use of the surface delta interactions. Next, we present discussions on the equivalence problem of the so-called LS triad and the Faddeev equation. The LS triad is a set of three LS equations, one inhomogeneous and two homogeneous, believed to be equivalent to the Faddeev equation. We point out that this common belief is not well founded, and show how the LS triad should be modified so that it becomes truely equivalent to the Faddeev equation. This consideration leads us to two important conclusions: (1) Contrary to the common misapprehension, the triad of the LS equations is necessary even when there exist no rearrangement channels. (2) It is necessary to consider the problem of the compactness of the integral kernel in addition to and independent of the Moller operator approach of Sandhas. This follows from the fact that, although the Moller operator approach leads naturally to the usual LS triad, it cannot lead to the alternative LS triad that is truely equivalent to the Faddeev equation.

2381 (RCNP-P—96, pp 63-67) **Construction of Pauli-correct separable cluster-cluster potentials.** Suzuki, Takanobu; Samata, Kazuhiko; Kamada, Hiroyuki; Oryu, Shinsho. (Science Univ. of Tokyo, Noda, Chiba (Japan). Faculty of Science and Technology). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

We construct effective cluster-cluster potentials from microscopic point of view so that we analyze the three-cluster model of the light nucleus by the three-body Faddeev equations. Our potentials are based on the resonating group method (RGM) by which a lot of works in the cluster physics have been carried out. Pauli-correct separable potentials between two-clusters such as α, /sup 3/He, t, d, n and p are presented in the momentum space representation.

2382 (RCNP-P—96, pp 68-72) **Two-body photodisintegration of three-nucleon system.** Saito, T.; Ishikawa, S.; Sasakawa, T. (Tohoku Univ., Sendai (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

Total cross section for the two-body photodisintegration of /sup 3/H has been calculated at E/sub γ/ $<$ approx 30 MeV. For the /sup 3/H wave function we have used exact solutions of Faddeev eqs. with realistic potentials (Argonne, TRS, RSC, PARIS and BONN with or without the Tucson-Melbourne three body force). We find that 1) these potentials except for BONN give us similar results, 2) the contribution from the higher partial weves of the triton is small, 3) the three body force makes the cross section smaller. However, it is expected that the final state interaction enhances it, so that the experimental value will be reproduced by taking account of the above two effects.

2383 (RCNP-P—96, pp 73-77) **D/sub 2/ parameter of the α particle and nucleon-nucleon force.** Morita, Hiko. (Hokkaido Univ., Sapporo (Japan). Dept. of Physics). 1988. NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

We find that the D/sub 2/ parameter of the α particle is strongly sensitive to the short-range behaviour of nucleon-nucleon forces. This fact suggests the possibility of verifying the NN force phenomenologically from the analysis of the D/sub 2/ parameter.

2384 (RCNP-P—96, pp 78-83) **Calculation of three-nucleon scattering problem in coordinate space.** Ishikawa, Souichi. (Tohoku Univ., Sendai (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

Three-nucleon scattering problem is formulated in a mixed representation of coordinate-, and momentum space. Long range property caused from three-body breakup channel is discussed.

2385 (RCNP-P—96, pp 84-88) **Deuteron breakup reaction by low energy neutron.** Takemiya, Toshinori; Saitoh, Jun. (Kumamoto Univ. (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

The general formalism of T matrix for the deuteron breakup reaction by low energy neutron D(n,p)nn is derived from the solution of Faddeev equation. The T matrix is given as a summation of two terms : the final state interaction and the direct interaction terms. Decomposing the Faddeev equation into partial wave states and making use of only the S wave state for interacting pair, the energy distribution of proton in the reaction D(n,p)nn at the incident neutron energy 14.1 MeV is shown. The final state interaction peak fits well with the experimental data. The experimental final state interaction peak is explained as an interference of the final state interaction and the direct interaction terms.

2386 (RCNP-P—96, pp 89-95) **Measurement of K/sub y//sup y'/ in p-d breakup reaction at 65 MeV.** Shimizu, H.M.; Nakamura, M.; Yosoi, M. and others. (Kyoto Univ. (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

Polarization transfer coefficients K/sub y//sup y'/ were measured for the /sup 2/H(p,p')pn reaction at E/sub p/ = 65 MeV. The measurement was performed at 8,10,12,15,20,25 and 35 degrees in laboratory angle under kinematically incomplete conditions. A large spin flip was observed slightly beyond the breakup threshold and especially at forward angles.

2387 (RCNP-P—96, pp 101-105) **On the n-d elastic scattering.** Koike, Yasuro. (Hosei Univ., Tokyo (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE89780017/JAW. (CONF-8712120—).

From Workshop on few-body systems; Ibaraki, Japan (17 Dec 1987).

The present status of the three-nucleon scattering calculation is reported. Emphasis is made on the accuracy of the calculation. It is shown that the calculation is very satisfactory in the cross sections but not in the analyzing power.

2388 (RCNP-P—97, pp 1-10) **Cluster structure in highly-excited states of light nuclei. Multi-cluster approach.** Kato, Kiyoshi. (Hokkaido Univ., Sapporo (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

The cluster structure in the highly-excited states of light nuclei are investigated using the multi-cluster model. For this purpose, we propose a developed treatment method of the multi-cluster model. The method consists of two parts: One is a systematic construction method of the multi-cluster Pauli-allowed states. Another is a truncation method of the large model space of the multi-cluster system. We show that we can easily solve the equation of the orthogonality condition model (OCM) for complex multi-cluster systems by the use of the method. We apply the multi-cluster models 3α, 4α, /sup 12/C + 2α and /sup 16/O + 2α to /sup 12/C, /sup 16/O, /sup 20/Ne and /sup 24/Mg, respectively. As shown in the Ikeda diagram, these models open a very interesting problem not only of the cluster structure in the highly-excited states of those nuclei but also of the structure change between different cluster structures. We show a typical example of the /sup 16/O + 2α model for /sup 24/Mg ; 1) many excited states with the /sup 20/Ne-α cluster structure are obtained at excitation energies above 10 MeV, 2) the /sup 16/O-/sup 8/Be cluster states are obtained at the energy region higher than 20 MeV, and 3) the very interesting states with the α-/sup 16/O-α linear-chain-like structure are predicted at about 20 MeV excitation energy.

2389 (RCNP-P—97, pp 11-15) **4α model calculation of /sup 16/O-nucleus by the Faddeev-Yakubovsky equations and effects of the 3-body (cluster) force.** Oryu, Shinsho; Sekiguchi, Hisao; Nishino, Tomohide; Kamada, Hiroyuki. (Science Univ. of Tokyo, Noda, Chiba (Japan). Faculty of Science and Technology). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

On the bases of 4α-model for the /sup 16/O-nucleus, the energy spectra of 0/sub 1//sup +/ states are investigated by using the 4-body Faddeev-Yakubovsky equations. The adopted α-α interaction is the rank-one 0 CM equivalent Fujiwara-Tamagaki potential in which the Coulomb force is not taken into account. The cal-

culation is carried out by considering the angular momentum sets of (0, 1, 2) and (0, 2, 4) for [3 + 1] and [2 + 2] channels respectively. We obtained -35.6 MeV, -23.5 MeV and -22.2 MeV under the threshold energy (-16.9 MeV) of 3α configuration of /sup 12/C-nucleus. A simple estimation of the Coulomb effect seems to support the existence of the three-body force.

2390 (RCNP-P—97, pp 18-24) **Group theoretical approach to study by cluster model. Nuclear symplectic model.** Suzuki, Yasuyuki. (Niigata Univ. (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

Both cluster and symplectic models are microscopic models incorporating core excitations. They play complementary reles to each other. The symplectic model, Sp(6,R), is particularly effective in explaining isoscalar E2 strength at giant quadrupole resonance region. The technique developed in the symplectic model can also be applied to a construction of Pauli-allowed states of multi-cluster systems.

2391 (RCNP-P—97, pp 87-92) **Application of coupled-rearrangement-channels variational method to few nucleon systems with realistic nucleon-nucleon interactions.** Kameyama, H.; Kamimura, M.; Fukushima, Y. (Kyushu Univ., Fukuoka (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

The applicability of coupled-rearrangement channels method which makes use of Gaussian basis functions to few nucleon systems is investigated. Results are presented for deuteron with Reid soft core potential and A = 3, 4 nuclei with Malfliet-Tjon potential, and the values are compared with those of other methods. It has shown that this variational method is very useful to study these light nuclei.

2392 (RCNP-P—97, pp 93-97) **Microscopic study of the inter-nucleus potential.** Yamaguchi, Shinichiro; Horiuchi, Hisashi; Yabana, Kazuhiro. (Kyoto Univ. (Japan). Dept. of Physics). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

The nucleus-nucleus potential is studied on the basis of the realistic complex G-matrix and the microscopic many body theory. The many body theory which takes into account of the Pauli principle is formulated based on the complex generator coordinate method in order to calculate the consistent real and imaginary parts of the inter-nucleus potential simultaneously by the use of the complex effective two-body interaction. This many body theory with the effective interaction CEG is applied to the alpha-alpha elastic scattering.

2393 (RCNP-P—97, pp 128-129) **On α-decays and exotic decays.** Okabe, Shigeto. (Hokkaido Univ., Sapporo (Japan). Center for Information Processing Education). 1988. (In Japanese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88780018/JAW. (CONF-8712121—).

From Workshop on clustering aspects in nuclear structures and nuclear reactions; Ibaraki, Japan (14 Dec 1987).

We report the present situations of theoretical investigations on α-decays and exotic decays from the cluster model approach.

2394 **(WHC-SA—0327) REAC2: Status of codes and libraries.** Mann, F.M. (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1988. Contract AC06-87RL10930. 5p. (CONF-881031—25). NTIS, PC A02/MF A01. Order Number DE89001918/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

Radioactivity in fusion facilities is not made by the fusion process itself, but rather by neutron activation of the surrounding materials. Thus, in principle, fusion facilities can be designed to minimize the amount of radioactivity. The REAC2 code system calculates the production of radioactive species and the transmutation of the elements. The code and libraries form an easy to use system that has been valuable for activation and transmutation studies. 11 refs.

2395 **Test of the O(6) character of nuclei near A = 130.** von Brentano, P.; Gelberg, A.; Harissopulos, S.; Casten, R.F. (Institut fuer Kernphysik der Universitaet zu Koeln, 5000 Koeln 41, Federal Republic of Germany). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 5, 2386-2388(Nov 1988).

The lifetimes of the lowest 2^+ and 4^+ levels can distinguish between the O(6) and U(5) dynamical symmetries of the interacting boson model. The data for the A = 130 nuclei confirm the proposed O(6) character of these nuclei.

2396 **Ring diagram nuclear matter calculations using Bonn and V/sub 14/ potentials.** Jiang, M.F.; Kuo, T.T.S.; Muether, H. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 5, 2408-2415(Nov 1988).

We calculate the particle-particle and hole-hole ring diagrams of nuclear matter to all orders using the Bonn and V/sub 14/ nucleon-nucleon potentials. Comparing with the results obtained from the lowest-order Brueckner-Hartree-Fock calculations of nuclear matter, these ring diagrams have the effect of both increasing the binding energy per nucleon (BE/A) and decreasing the saturation momentum (k/sub F/). Our calculated values for BE/A in MeV and k/sub F/ in fm/sup -1/ for the V/sub 14/ potential are (16.8, 1.45), and for the Bonn potential (17.5, 1.57). The effect of the ring diagrams is found to be more important for the V/sub 14/ potential than for the Bonn potential. The choice of the model space and the resulting single-particle potential for particles above the Fermi sea are discussed.

2397 **Azimuthal distributions in heavy ion collisions and the nuclear equation of state.** Welke, G.M.; Prakash, M.; Kuo, T.T.S.; Das Gupta, S.; Gale, C. (Physics Department, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 5, 2101-2107(Nov 1988).

For near central collisions of Nb on Nb at a laboratory energy of 650 MeV per projectile nucleon we calculate inclusive cross sections as a function of the azimuthal angle where this angle is measured from the reaction plane. The azimuthal dependence is strongly influenced by the nuclear equation of state and is a useful quantity to measure.

2398 **Excitation of the Δ resonance in the /sup 12/ C(e,e') reaction.** Chen, C.R.; Lee, T.H. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **38**: No. 5, 2187-2192(Nov 1988).

The inclusive (e,e') scattering from nuclei is studied with the assumption that the electromagnetic production of pions from the nucleon can be described by a model consisting of the conventional Born term and a Δ-excitation term. We show that the global features of the recent data of the inclusive /sup 12/C(e,e') reaction in the GeV energy region can be described by the following procedures: (1) the parameters of the constructed one-body and two-body current operators are fitted to the total cross sections of $\gamma N \rightarrow \pi N$, p(e,e'), and $\gamma d \rightarrow np$; (2) the medium effect on the Δ propagation is treated according to the information extracted from the Δ-hole model calculation. It is found that the two-body mechanism of Δ annihilation by the nuclear medium improves the fit to the data in the "dip" region. The predicted magnitudes in the Δ region are lower than the data, indicating the importance of more complicated multinucleon mechanisms.

2399 **One-nucleon knockout by pions and deltas.** Takaki, T.; Thies, M. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2230-2244(Nov 1988).

We present the first quantitative study of the (π,π'N) coincidence reaction within the Δ-hole model and compare our results to recent Swiss Institute for Nuclear Research (SIN) and LAMPF data for /sup 16/O near 240 MeV. A modified distorted-wave impulse approximation (DWIA), including medium corrections to the Δ propagator and containing no free parameters, reproduces the leading (π^+,π^+ p) channel for p-shell knockout satisfactorily, provided we use shell-model spectroscopic factors. The weak (π^-,π^- p) and (π^+,π^0p) channels are found to be sensitive to interference effects between the DWIA mechanism and knockout induced by ΔN collisions. This latter two-step process is also calculated microscopically, using a simple form for the Δ-N interaction guided by pion absorption. Our model qualitatively confirms earlier estimates, but cannot reproduce the isospin ratios over the whole kinematical range. In particular, it systematically underestimates the charge-exchange cross sections by 30%.

2400 **Elastic scattering of protons by /sup 16/O, /sup 40/Ca, and /sup 208/Pb at 200, 500, and 800 MeV: Relativistic and nonrelativistic analyses based on the impulse approximation.** Ottenstein, N.; Wallace, S.J.; Tjon, J.A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2272-2288(Nov 1988).

Systematics of Dirac impulse approximation predictions for cross sections and spin observables in elastic proton scattering by /sup 16/O, /sup 40/Ca, and /sup 208/Pb at energies of 200, 500, and 800 MeV are presented. The analysis is based on an optical potential constructed from complete sets of Lorentz-invariant NN amplitudes. The NN amplitudes are determined from a relativistic meson exchange model of the nuclear force. Comparisons are made with the original form of the Dirac impulse approximation, which is based on five Fermi terms to represent the NN interaction, and with the Schroedinger form of the impulse approximation. For the Dirac analyses, there is implicit coupling to virtual nucleon-antinucleon states. In order to illustrate these contributions, the Dirac equation is recast in the form of the Schroedinger equation and the resulting Schroedinger potentials are separated into "no-pair" and virtual-pair parts. The resulting virtual-pair part of the central potential is typically 25 MeV at the center of the nucleus for 200—800 MeV protons. A reasonable description of the experimental data is obtained over a broad energy range and over a wide variation of nuclear size when the analysis is based on complete sets of Lorentz-invariant amplitudes.

2401 **Elastic scattering of protons by /sup 16/O, /sup 40/Ca, and /sup 208/Pb at 200, 500, and 800 MeV: Effects of vacuum polarization and Pauli-blocking corrections.** Ottenstein, N.; Wallace, S.J.; Tjon, J.A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *C: Nuclear Physics;* **38**: No. 5, 2289-2295(Nov 1988).

Dirac impulse approximation predictions for cross sections and spin observables in elastic proton scattering by /sup 40/Ca and /sup 208/Pb at energies of 200, 500, and 800 MeV are presented. The analysis is based on complete sets of Lorentz-invariant NN amplitudes determined from a meson-exchange model of the nuclear force. Effects of relativistic nuclear densities are explored including estimates of the vacuum polarization corrections based on quantum hadrodynamics. Effects of Pauli blocking are considered using the approximations of Murdock and Horowitz. A good description of the experimental data is obtained over a broad energy range and over a wide variation of nuclear size based on the generalized impulse approximation. Vacuum polarization corrections are found to enhance the agreement between theory and experiment.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 631, 964, 1053, 1940, 2082, 2655

2402 **(FEI—1850) Convergence of an explicit method of nontotal factorization when solving many-dimensional difference elliptical-type equations.** Artem'ev, V.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704438/JAW.

Investigation of wide range of diffusion stationary processes and convectional transport leads to solution of differential second-order elliptical-type equations. On finite-difference solution of these equations systems the algebraic high-order equations are brought about. Method of nontotal factorization is the effective iterative method for solution of such systems, especially for problems with high-changing coefficients, general boundary conditions, range boundaries not parallel to coordinated lines. Proof of convergence of an explit method of nontotal factorization when solving n-dimensional (n≧2) difference elliptical-type equations is given. Calculation evaluations are presented. In case of self-conjugate problem the energy equivalency evaluations, allowing to use the Chebushev set of parameters for convergence acceleration, are found. Test calculation results, comparison with other methods are presented. 11 refs.; 5 tabs.

2403 (IAEA-TECDOC—469, pp 67-77) **Inelastic neutron scattering (neutron spectrometry).** Simakov, S.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

Consideration is given to experimental methods of inelastic neutron interaction differential cross-section measurement, with a neutron or γ-quantum detected in the exit channel. In this case the principal emphasis is placed on the method of time-of-flight neutron spectrometry. The paper deals with the physical and methodological aspects of the method associated with neutron generation, detector shielding and determination of its performance, final scatterer dimensions correction control, separation of elastic and inelastic neutron scattering. Presentation is given to a correlation experiment technique, which allows a neutron spectrum from the (n,n') reaction to be detected when the channel is open for the (n,2n) reaction as well. Possibilities of the methods are illustrated by the experimental data on cross-sections of the processes. (author). 46 refs, 9 figs, 2 tabs.

2404 (IAEA-TECDOC—469, pp 77-88) **Reaction cross-sections for reactor dosimetry and activation calculation.** Pashchenko, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

The current status of threshold reaction cross-section data for reactor dosimetry and activation calculation was reviewed. Systematic (n,p) and (n,2n) reaction cross sections at {similar←to} 14 MeV were presented. The analytical representation of energy dependence of cross sections was discussed. Comparison of evaluated cross sections with integral experimental data has shown that on the whole, a good agreement of recommended cross-section averaged over the neutron spectrum of /sup 235/U thermal neutron fission with the integral experiment results is observed. (author). 26 refs, 4 figs, 2 tabs.

2405 (IAEA-TECDOC—469, pp 108-111) **Definition of the problem of neutron spectra unfolding by measured reaction rates.** Bondars, H.Ya. (Latvijskij Gosudarstvennyj Univ., Riga (USSR)). Aug 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704485/JAW. (CONF-8705343—).

From Interregional training course on neutron physics and neutron data measurements with accelerators and research reactors; Leningrad, USSR (18 May 1987).

The paper describes the main mathematical and physical features of the problem, determines the role of the initial approximations, classifies the methods of unfolding and errors and lastly defines the task of neutron spectra unfolding by measured reaction rates. (author). 22 refs.

2406 **(IFVE-ORI—87-59) Simulation of nuclear interactions in high energy hadronic cascade calculations.** Mokhov, N.V.; Striganov, S.I.; Uzunyan, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704500/JAW.

The general requirements to hA-event codes for high energy cascade simulations are discussed. A review is given for exclusive and inclusive hA-generators which are used at present. The phenomenological model which is the basis of the MARS program inclusive generator is described. 49 refs.; 7 figs.

2407 **(INIS-GB—83) Synchrotron radiation. Appendix to the Daresbury annual report 1985/86.** Norman, D.; Walker, R.P.; Durham, P.J.; Ridley, P.A. (comps.). (Daresbury Lab. (UK)). 1986. 228p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88780101/JAW.

The paper on synchrotron radiation is the appendix to the Daresbury (United Kingdom) annual report, 1985/86. The bulk of the volume is made up of the progress report for the work carried out during the year under review using the Synchrotron Radiation Source (SRS) at Daresbury. The Appendix also contains: the scientific programmes at the SRS, progress on beamlines, instrumentations and developments, and activities connected with accelerator development. (U.K.).

2408 **(JAERI-M—88-114) Vectorization techniques for neutron transport Monte Carlo codes.** Suganuma, Masayuki; Higuchi, Kenji; Asai, Kiyoshi; Kurita, Yutaka. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jun 1988. 50p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755218/JAW.

Four Monte Carlo codes, KENO IV, MORSE-DD, MCNP and VIM, have been vectorized already at JAERI Computing Center aiming at an increase in clculation performance, and speed-up ratios of vectorized codes to the original ones were found to be low values between 1.3 and 1.5. In this report the vectorization processes for these four codes are reviewed comprehensively, and methods of analysis for vectorization, modification of control structures of codes and debugging techniques are discussed. The reason for low speed-up ratios is also discussed.

2409 **Grey transport acceleration method for time-dependent radiative transfer problems.** Larsen, E. (Department of Nuclear Engineering, University of Michigan, Ann Arbor, Michigan 48109). *Journal of Computational Physics;* **78**: No. 2, 459-480(Oct 1988).

A new iterative method for solving hte time-dependent multifrequency radiative transfer equations is described. The method is applicable to semi-implicit time discretizations that generate a linear steady-state multifrequency transport problem with pseudo-scattering within each time step. The standard "lambda" iteration method is shown to often converge slowly for such problems, and the new grey transport acceleration (GTA) method, based on accelerating the lambda method by employing a grey, or frequency-independent transport equation, is developed. The GTA method is shown, theoretically by an iterative Fourier analysis, and experimentally by numerical calculations, to converge significantly faster than the lambda method. In addition, the GTA method is conceptually simple to implement for general differencing schemes, on either Eulerian or Lagrangian meshes. copyright 1988 Academic Press, Inc.

2410 **Effects of incoherent and coherent scattering on the exposure buildup factors of low-energy gamma rays.** Hirayama, H.; Trubey, D.K. (National Lab. for High Energy Physics, 1-1 oho, Tsukuba-shi, Ibaraki-ken 305 (JP)). *Nuclear Science and Engineering;* **99**: No. 2, 145-156(Jun 1988).

The effects of including incoherent and coherent scattering in a calculation of the exposure buildup factors for plane normal gamma-ray sources have been investigated by using an electron-gamma-ray shower Monte Carlo code, EGS4, for water, iron, and lead in the 40- to 200-keV range. The "true" buildup factors for practical uses are defined to clarify the effects of bound-electron Compton (incoherent) and coherent scattering and are tabulated for penetration depths up to 10 mfp. The pseudo buildup factor increases by including incoherent scattering and decreases by including coherent scattering. The degree of each effect varies with the atomic number of the material. The effect of incoherent scattering is large for materials of small atomic number, and the effect of coherent scattering is large for materials of large atomic number.

6550 Medical Physics

REFER ALSO TO CITATION(S) 600, 1923, 2673

2411 **(CONF-881032—3) Review of ANSI [American National Standards Institute] N13.11: A status report.** Sims, C.S. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01. Order Number DE89001691/JAW.

From 2. conference on radiation protection and dosimetry; Orlando, FL, USA (31 Oct 1988).

In 1983, the American National Standards Institute (ANSI) issued the dosimetry standard titled "Personnel Dosimetry Performance -- Criteria for Testing" as ANSI N13.11. This standard forms the basis for the National Voluntary Laboratory Accreditation Program (NVLAP) which has become familiar to dosimeter processors in recent years. This standard is particularly important because the Nuclear Regulatory Commission (NRC) requires that all licensees have personnel dosimetry devices processed by processors that are NVLAP accredited. This standard is currently undergoing review and modifications are going to be made. This paper contains a brief history of the events leading to the development of ANSI N13.11 - 1983, information concerning the present standard and associated performance test results, and the selection of the review group. Following that, the status of the review is presented and statements regarding the future outlook for the standard are made. 10 refs., 5 tabs.

2412 (DOE/ER/60631—1, pp 35-41) **Dielectric response function for water. I. Calculation of the form factor.** Zaider, M. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

The goal of this calculation is to evaluate the dielectric function for water and its dependence on frequency and wave vector. For this purpose, the author is using the expression given by Ehrenreich and Cohen.

2413 (DOE/ER/60631—1, pp 76-78) **Microdosimetry of an epithermal neutron beam.** Kliauga, P. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

The work reported here was performed in order to investigate the usefulness of microdosimetry applied to these beams as a tool for characterizing the beam, and to supply corroborating evidence for independent measurements done with conventional ionization chambers. All spectra reported here were taken with a standard 2.54-cm spherical proportional counter with a 3.175-mm tissue-equivalent (TE) plastic wall. The counter was filled with propane-base TE gas to a pressure of 16.5 Torr, simulating a 1-μm diameter

site in unit-density tissue. The counter was placed in front of the experimental beam port at the BMRR. Beam intensity was adjusted to obtain a counting rate between 1000 and 1500 cps. Electronic pile-up rejection was employed to provide further insurance against spectral distortion due to electronics. Calibration was done with a soft-X-ray source (aluminum characteristic X rays, 1.495 keV).

2414 (DOE/ER/60631—1, pp 83) **Construction and testing of a water target for single-track radiation chemistry.** Randers-Pehrson, G. Jul 1988. NTIS, PC A06/MF A01. Order Number DE88015151/JAW.

In Radiation physics, biophysics, and radiation biology: Progress report, December 1, 1987-November 30, 1988.

A novel technique is proposed for obtaining information on the nanosecond time-scale decays of species produced by the interaction of charged particles with water. Briefly, rather than using a traditional pulsed beam (in which a large number of particles are bunched together into a very short time interval), they shall optically sample the water volume traversed by the charged particles after each individual traversal. The effect observed will be the time development of the attenuation of light beam which interacts with a given species being studies (solvated electrons will be studied first). The major technical problem with this experiment is the construction of a water target of about 1 μm diameter and several tens of microns thickness. They have constructed two prototype targets this year. The first one was a 25-μm thick foil containing a 2.5-μm pinhole. Water was constrained to the surface by two teflon plates with (hydrophobic) capillary passages. The water thickness was measured to be 35 μm using energy loss from a 3-MeV proton beam traversing the aperture. The second target has been constructed with a more substantial holder so that alignment with the particle beam can be accomplished. It is also provided with channels so that water can flow through the target. This target is presently being tested for flow rates through various apertures of about 10-μm diameter. They are also investigating filtration systems to prevent the clogging of smaller apertures.

2415 (DPST—88-625) **An interlaboratory calibration of the M-area assay monitor.** Sigg, R.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 14 Jun 1988. Contract AC09-76SR00001. 12p. NTIS, PC A03/MF A01. Order Number DE89001405/JAW.

An interlaboratory calibration has established a measurement basis for the SRL-developed 320-M Solution Assay Monitor (SAM). The calibration removes any bias between New Brunswick Laboratory measurements and SAM gamma-ray results for U-235 in HCl solutions. The comparison also shows that the SAM provides accountability quality precision and accuracy for the entire range of useful concentrations. 5 refs., 2 figs., 6 tabs.

2416 (NRPB-R—190) **Natural radiation exposure in UK dwellings.** Wrixon, A.D.; Green, B.M.R.; Lomas, P.R.; Miles, J.C.H.; Cliff, K.D.; Francis, E.A.; Driscoll, C.M.H.; James, A.C.; O'Riordan, M.C. (National Radiological Protection Board, Chilton (UK)). May 1988. 188p. H.M. Stationery Office, London, price Pound 10.00.

A survey of gamma-ray dose rates and radon concentrations in 2000 UK dwellings has been carried out. This shows the mean annual effective dose equivalents from gamma-rays and radon decay products in dwellings are 280 and 1000 μSv, respectively. When account is taken of exposures elsewhere, mean annual doses from these sources are about 350 and 1200 μSv, respectively, the latter being greater than previous estimates because of a reassessment of conversion factors between exposure and dose. Mean annual dose from thoron decay products is about 150 μSv. More detailed surveys in regions of the UK with elevated concentrations of natural radioactivity in rocks and soil have shown that radon concentrations vary widely, sometimes resulting in annual effective dose equivalents exceeding 100 mSv. Doses from gamma-rays and thoron decay products are much less variable, with maxima around 1 mSv/year. Although the radon concentrations indoors are clearly related to local geology, weaker influences can be discerned, such as the storey on which measurement is made and the presence of double glazing.

2417 (ORAU—88/A-73, pp 79-85) **Building the basis for comprehensive radiation-protection training for a multi-program laboratory.** Copenhaver, E.D. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

During the last two years an explicit, workplace-specific training program has been developed, implemented, and documented for all radiation workers at Oak Ridge National Laboratory (ORNL). In addition to the radiation workers at reactors, accelerators, radiochemical laboratories, and waste-treatment areas, training has been extended to personnel who work in areas with lower potential for radiological/chemical exposures. These workers include construction crews, site-restoration crews, site-characterization teams, and short-term visitors. Based on the needs of these groups of workers, a comprehensive, integrated approach to radiation-protection training suitable for a multi-program research laboratory is being developed. 7 references, 3 figures.

2418 (ORAU—88/A-73, pp 87-94) **Tailoring training to the need: reaching all the workers.** Jones, E. (Oak Ridge National Lab., TN (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

By developing a comprehensive concept for radiation-protection training at Oak Ridge National Laboratory (ORNL), a complete program is being provided with the flexibility to add more radiation-protection training upon demand. A framework for implementation of a program tailored to reach differing segments of the work force quickly and effectively is outlined and illustrated. 10 references, 7 figures.

2419 (SSI—87-34) **Radiation protection and atomic energy legislation in the Nordic countries.** Persson, L. (National Inst. of Radiation Protection, Stockholm (Sweden)). 3 Dec 1987. 108p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88755276/JAW.

The radiation protection and atomic energy laws of the Nordic countries Denmark, Finland, Iceland, Norway and Sweden are presented in this report in their status of March 1, 1984. As a background to this legislation the Nordic co-operation is briefly reviewed and the common basis for the legal texts is given. Some historical remarks for the legislation of each country are included.

2420 (WHC-SA—0202) **An arm phantom for in vivo determination of Americium-241 in bone.** Kephart, G.S.; Palmer, H.E. (Westinghouse Hanford Co., Richland, WA (USA)). Apr 1988. Contract AC06-87RL10930;AC06-76RL01830. 28p. (CONF-880729—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE89001911/JAW.

From 33. annual meeting of the Health Physics Society; Boston, MA, USA (4 Jul 1988).

The focus of this research has been to construct a realistic arm phantom as a calibration tool in estimation of ^{241}Am in the bone. The United States Transuranium Registry (USTR), through its program of whole body donations, continues to provide data on transuranic incorporation in man that would not otherwise be readily available (Norwood 1972; Breitenstein 1981; Swint, et al. 1985). This project uses well-characterized human bones loaned by the USTR for the construction of realistic phantoms for improvement of whole-body counter calibrations. 27 refs., 2 figs., 4 tabs.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 1024, 1029, 1098, 1121, 1121, 1152, 1415, 2374

2421 (ACIESP—60-Vol.1, pp 73) **Experimental studies on surface confined quiescent plasmas at INPE.** Ferreira, J.L.; Ferreira, J.C.; Sandonato, G.M.; Ludwig, G.O.; Montes, A.; Alves, M.V. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2422 **(AD-A—196322/2/XAB) Inelastic ion-surface collisions. Ion neutralization on intermetallic surfaces. Technical report.** Rabalais, J.W. (Houston Univ., TX (USA). Dept. of Chemistry). 1 Jun 1988. 17p. (SCIENTIFIC—2). NTIS, PC A03/MF A01.

Ion-scattering and direct-recoil spectrometries were used to investigate electronic excitation and charge-transfer processes occurring during rare-gas-ion bombardment of CuLi alloy. Excitations in the close encounter appear to be governed by the degree of inner-shell mixing between the colliding pair. Excitations in the outgoing trajectory are governed by the probabilities of Auger and resonant charge exchange between the scattered or recoiled particle and the surface. Measurements of the vacuum-ultraviolet photon emission of the scattered and recoiled particles proved to be unsuccessful due to low photon yields. The ion-induced surface damage to transition-metal fluoroanions was investigated by XPS and UPS. Ion bombardment reduces the transition-metal atom to lower oxidation states, in some cases all the way to the metal. These results are consistent with the thermal spike model of ion damage.

2423 **(BNL—41731) Photoemission and glancing-angle EXAFS [X-ray Absorption Fine Structure] studies of vacuum deposited Al/Cu bilayers.** Di Marzio, D.; Chen, H.; Ruckman, M.W.; Heald, S.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016;AS05-80ER10742. 19p. (CONF-881002—13). NTIS, PC A03/MF A01. Order Number DE89001271/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

The effects of oxygen exposure and substrate temperature on the structure and chemical composition of vacuum deposited Al/Cu and Al/O_2/Cu bilayers are studied using photoemission and glancing-angle extended x-ray absorption fine structure (EXAFS) measurements. Use of these complementary techniques permits detailed atomic level characterization of thin film structure nd chemical composition during thin film deposition in vacuum or thin film modification by heat treatment in air. In absence of oxygen contamination, photoemission indicates significant interfacial reaction at room temperature at the Al/Cu interface. Glancing-angle EXAFS shows that an Al-rich Cu-Al alloy forms at the interface at room temperature. Heat treatment promotes alloy formation and $CuAl_2$ forms at temperatures from 120 to 150{degree}C. For interface formed after substrate oxygen exposure significant alloying is still observed and Al reduced the Cu-O substrate leading to the formation of Cu-Al and Al_2O_3-compounds at room temperatures. Annealing the oxygen exposed interface leads to the formation of a $CuAl_2$ phase but at higher temperatures than was observed for sampled produced in ultrahigh vacuum. 20 refs., 5 figs.

2424 **(BNL—41814) EXAFS studies of interfaces in bilayers and multilayers.** Heald, S.M.; Chen, H.; Lamble, G.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 10p. (CONF-8808149—1). NTIS, PC A02/MF A01. Order Number DE89002176/JAW.

From 5. international conference on X-ray absorption fine structure; Seattle, WA, USA (21 Aug 1988).

EXAFS is demonstrated to be a useful probe of interface structure. Glancing angle techniques can be used on bilayer samples for cases in which the overlayer is less dense than the substrate. It is shown that the anomalous dispersion distortions which affect the EXAFS signal can be accurately removed using an analytic model for δ_0 and β_0, allowing quantitative analysis to be carried out. Examples are given for the Cu-Al system. In other cases multilayer samples can be employed to enhance the interface signal, as is illustrated by results on W-C multilayers. A disadvantage of multilayers is that two types of interfaces are simultaneously probed. To deal with this standing wave techniques can be employed to selectivity enhance the EXAFS signal from regions within the multilayer unit cell, and results on Ni-Ti demonstrate the feasibility of this approach. 6 refs., 5 figs.

2425 **(CONF-8801115—1) Soft x-ray absorption and emission spectra and the electronic structure of some exotic materials.** Ederer, D.L.; Canfield, L.R.; Callcott, T.A.; Tsang, K.L.; Zhang, C.H.; Arakawa, E.T. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01. Order Number DE89001207/JAW.

From X-ray and vacuum ultraviolet interaction data bases, calculations, and measurements; Los Angeles, CA, USA (14 Jan 1988).

The technique of soft x-ray fluorescence spectroscopy (SXE) is complimentary to that of photoemission spectroscopy (PES). SXE probes the local partial density of states (PDOS), selects dipole allowed symmetries, and is not necessarily surface sensitive. PES on the other hand, averages over the DOS and can be used to measure the dispersion of the energy bands. PES is also very surface sensitive. We present measurements on the high T/sub c/ superconductors, the quasicrystalline phase of AlMn, and the LiAl intermetallic alloy. These measurements provide insight for theoretical modeling. In the case of the high T/sub c/ compound and the intermetallic compound the measurements are in good agreement with the theory. However, for the quasicrystals the measurements provide new insights to challenge theory. 13 refs., 3 figs.

2426 **(CONF-8804141—5) Phase effects for electrons in liquid water and water vapor.** Turner, J.E.; Paretzke, H.G.; Wright, H.A.; Hamm, R.N.; Ritchie, R.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01. Order Number DE89001699/JAW.

From 11. Werner Brandt workshop on penetration phenomena of charged particles in water; Oak Ridge, TN, USA (14 Apr 1988).

The objective of these studies is to compare transport, energy loss, and other phenomena for electrons in water in the liquid and vapor phases. Understanding the differences and similarities is an interesting physics problem in it own right. It is also important for applying the relatively large body of experimental data available for the vapor to the liquid, which is of greater relevance in radiobiology. This paper presents a summary of results from a series of collaborative studies carried out by the authors at Oak Ridge National Laboratory (ORNL) and the Gesellschaft fuer Strahlen- und Umweltforschung (GSF). 14 figs.

2427 **(DOE/ER/40374—5) [Winter workshop on universalities in condensed matter physics, Les Houches, France, March 15-24, 1988]: [Foreign trip report].** Hu, Bambi. (Houston Univ., TX (USA). Dept. of Physics). [1988]. Contract FG05-87ER40374. 8p. NTIS, PC A02/MF A01. Order Number DE89001598/JAW.

This paper reports on the travel of Bambi Hu to France for a workshop on Universalities in Condensed Matter Physics. A very brief discussion is given on the workshop. His paper titled "Problem of Universality in Phase Transitions in Low-Symmetry Systems," is included in this report. (LSP)

2428 (INIS-BR—1275, pp 14) **Determination of local atomic structure of Ni/sub 2/Zr amorphous alloy by x-ray anomalous scattering using synchrotron radiation.** Lima, J.C. de; Raoux, D. (9150268FR). 1988. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704348/JAW. (CONF-8807125—).

From 10. workshop of the Brazilian Society of Crystallography and symposium on crystallography and new materials; Campinas, Brazil (18 Jul 1988).

2429 **(INIS-mf—11319) 33rd Annual conference and the 23rd annual theoretical seminar of the South African Institute of Physics.** (South African Inst. of Physics, Faure). 1988. 78p. (In English, Afrikaans). (CONF-8807126—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW.

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

This publication contains only the abstracts of seminars.

The 33rd annual conference and the 23rd annual theoretical seminar of the South African Institute of Physics was held from 4-8 July 1988 at Rhodes University, Grahamstown. This publication contains only the abstracts of seminars delivered on the conference. The topics that were covered include the various facets of physics such as solid state physics, nuclear and particle physics, optics and spectroscopy, solar-terrestrial physics, eduction, and applied and industrial physics.

2430 (INIS-mf—11319, pp 71) **Nuclear reaction profiling of implanted interstitial redistribution in diamond.** Derry, T.E.; Prins, J.F.; Ennis, J.; Spits, R.A.; Sellschop, J.P.F. (Schonland Research Centre for Nuclear Sciences, University of the Witwatersrand (South Africa)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2431 (INIS-mf—11319, pp 43) **Pulsed electron beam heating (PEH) and LASER processing of pure and Be-implanted InSb.** Alberts, H.W.; Cilliers, R. (Pretoria Univ. (South Africa). Dept. of Physics). 1988. (In Afrikaans). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2432 (INIS-mf—11319, pp 43) **Damage ranges in some metals after ion implantation.** Friedland, E.; Alberts, H.W. (Pretoria Univ. (South Africa). Dept. of Physics). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2433 (INIS-mf—11319, pp 45) **Effects of calcium dopants on the annealing characteristics of KCl x-irradiation at RT.** Xuza, V.A. (Fort Hare Univ. (South Africa)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2434 (INIS-mf—11319, pp 45) **Thermoluminescence mechanisms in KCl:Ag crystals.** Mdebuka, A.M.; Seretlo, J.R. (Fort Hare Univ. (South Africa)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2435 (INIS-mf—11319, pp 68) **Characterization of ion beam mixing induced defects in Si.** Auret, F.D.; Malherbe, J.B.; Nel, M.; Myburgh, G. (Port Elizabeth Univ. (South Africa). Dept. of Physics). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2436 (INIS-mf—11319, pp 68) **Subthreshold defect formation in epitaxial GaAs detected with DLTS.** Nel, M.; Auret, F.D. (Port Elizabeth Univ. (South Africa). Dept. of Physics). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2437 (INIS-mf—11319, pp 70) **Critical behaviour of the planar helical - paramagnetic phase transition in Dy and Ho.** Brits, G.H.F.; Du Plessis, V. (Atomic Energy Corp. of South Africa (Pty) Ltd., Pretoria; Rand Afrikaans Univ., Johannesburg (South Africa)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2438 (INIS-mf—11319, pp 71) **Thermoluminescence in some doped KCl crystals.** Mdebuka, A.M. (Fort Hare Univ. (South Africa)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2439 **(INPE—4254) Equilibrium stability of strained epitaxial layers on a rigid substrate.** Granato, E.; Kosterlitz, J.M.; Ying, S.C. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil); Brown Univ., Providence, RI (USA). Dept. of Physics). (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704565/JAW.

A simple theory of the equilibrium stability of an strained epitaxial layer on a rigid substrate is presented. We generalise the Frankvan der Merwe model of a single layer and consider N layers of adsorbate on a substrate. Continuum elasticity theory is used to describe each layer, but the coupling between layers is treated ina discrete fashion. Our method interpolates between a few layers and the thick film limit of standard dislocation theory, and in this limit the standard results are obtained. In addition, we developed a variational approach which agrees well with our exact calculations. The advantage of our method over previous ores is that it allows to perform stability analyses of arbitrary superlattice configurations.

2440 (IPPJ—859, pp 256-271) **Application of Rutherford backscattering for analyzing multilayered structure change induced by pulsed ion beam bombardment.** Sasaki, N.; Takagi, N.; Yano, S. (Kobe Univ. of Mercantile Marine (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

Using the proton backscattering technique, plane-shaped samples consisting of a double layered film Pb/parylene(polyparaxylene) chemically deposited on a silicon plate were analyzed after bombarded by pulsed proton beams of about 400 keV with different current densities upto 1 kA/cm/sup 2/. We obtained very clear backscattering spectra indicating changes of the layer-structure caused by LIB bombardment. Almost all Pb-layer was ablated, and the boundary between parylene and silicon became diffusive. This method is proved to be very useful for analysis of LIB bombarded samples.

2441 (JINR-D—14-88-11) Neutron studies of temperature dependence of dynamics and structure of superconducting ceramics La/sub 2-x/Sr/sub x/CuO/sub 4-y/. Belushkin, A.V.; Goremychkin, E.A.; Zajonts, V.; Natkanets, I.; Sashin, I.L.; Kadyrbaev, A.R.; Mikhajlov, B.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN SSSR, Moscow. Inst. Metallurgii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1988. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704599/JAW.

Submitted to the journal Pis'ma Zh. Ehksp. Teor. Fiz. .

The inelastic neutron scattering and neutron diffraction spectra from La/sub 2/CuO/sub 4-y/ and La/sub 1,8/Sr/sub 0,2/CuO/sub 4-y/ at 290 K,77 K and 10 K temperatures are investigated simultaneously with the KDSQG-M spectrometer on IBR-2 pulsed reactor. The new line at 6 MeV has been observed in inelastic spectra at 77 K and 10 K. The temperature dependence of this line intensity points to magnetic nature of the corresponding excitation. According to diffraction data, the samples under investigation had orthorhombic and tetragonal symmetry, respectively over all the temperaturee range. The manifestation of (100) reflection for orth-orhombic phase of La/sub 2/CuO/sub 4-y/ reveals the antiferromagnetic ordering at low temperatures. 11 refs.; 3 figs.; 1 tab.

2442 (JINR-R—14-87-922) Investigation of high temperature HoBa/sub 2/Cu/sub 3/O/sub 7-δ/ superconductor by the μSR-method. Graboj, I.Eh.; Grebinnik, V.G.; Gurevich, I.I. and others. (Moskovskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 3p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704657/JAW.

Submitted to the Organizing Committee of the International Workshop on the study of superconductors by μSR - method (Villigen, Switzerland, 23-25 February, 1988).

A high T/sub c/ superconductor HoBa/sub 2/Cu/sub 3/O/sub 7-δ/ (T/sub c/ ~ 93 K) has been invesigated by the μSR-method in a zero external magnetic field, the sample being cooled from the temperature much higher than T/sub c/ to T=4.2 K. Fast increasing of the muon spin depolartization in the temperature range 10-4.2 K is observed, which indicates the fluctuating production of the magnetic ordering in the HoBa/sub 2/Cu/sub 3/O/sub 7-δ/ compund under study. 3 refs.; 3 figs.

2443 (JINR-R—14-87-936) Depth profile determination of hydrogen in optical glasses. Il'khamov, R.A.; Khushmurodov, Sh.Kh.; Kobzev, A.P.; Osetinskij, G.M.; Pestrikova, M.V.; Ter-Nersesyants, V.E.; Shirokov, D.M. (Tashkentskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; Gosudarstvennyj Opticheskij Inst., Leningrad (USSR); Moskovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704658/JAW.

The result of the hydrogen depth profile determination in optical glasses by the proton elastic recoil detection using 2.2 and 2.4 MeV /sup 4/He ion beam from the Van de Graaf generator of JINR are presented. Concentration profile of hydrogen was calculated by modelling the energy spectrum of recoiled protons and comparison it with the experimental one. The hydrogen contents in various types of phosphate glasses and the influence of termal annealing on the concentration profile of hydrogen in the surface layers of lead-silicate glasses are investigated. 3 refs.; 8 figs.

2444 (JINR-R—14-88-44) Defect production in diamond with high energy ion implantation. Varichenko, V.S.; Zajtsev, A.M.; Kulakov, V.M.; Mel'nikov, A.A.; Plotnikova, S.P.; Stel'makh, V.F.; Didyk, A.Yu.; Kuznetsov, V.I.; Skuratov, V.A.; Shestakov, V.D. (Belorusskij Gosudarstvennyj Univ., Minsk). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1988. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704659/JAW.

Submitted to the journal Fiz. Tekh. Poluprovodn. .

Defect production mechanisms in diamond irradiated with high energy carbon (82 MeV) and coper (64 MeV) ions were studied by the cathodo- and photoluminescence techniques. The high energy implantation results in the formation of complicated spatial defect structure of the irradiated layer, electron stopping mechanisms being dominant in the defect production. 17 refs.; 6 figs.

2445 (LAFI—120) Anomalous effect of a high-frequency ultrasound on radiation diffraction in a deformed single crystal. Iolin, E.M.; Rajtman, Eh.A.; Kuvaldin, B.V.; Zolotoyabko, Eh.V. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1987. 25p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704668/JAW.

Results of theoretical and experimental studies on the neutron and X-ray diffraction in deformed crystals under high-frequency ultrasonic excitation are presented. It has theoretically been proved that at the frequancy higher than some threshold one, the ultrasound violates the adiabatic conditions for the motion of excitation points on the branches of the dispersion surface. This causes an anomalous (if compared with the diffraction on the perfect crystal) dependence of the diffraction intensity on the ultrasonic wave amplitude. Experimental data for the single Si crystal are in good agreement with theoretical predictions. 22 refs.; 12 figs.

2446 (LAFI—121) Color centers in rare earth gallium garnets. Matkovskij, A.O.; Sugak, D.Yu.; Ulmanis, U.A.; Savitskij, V.G. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1987. 42p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704669/JAW.

Some physical properties of rare earth gallium garnets (REGG) under the effect of ionizing radiations (high-energy photons, under 4 MeV electrons, over 0.1 MeV neutrons, ions, gamma and X radiations) have been investigated. It has been found that the ionizing radiation causes stable and short-living colour centre (CC) generation. These centres are completely destroyed by annealing at the temperatures over 470 K. Basing on the analysis of absorption spectra, thermoluminescence, temperature dependences of the REGG electro-physical parameters under the effect of various radiations and conditions, it has been shown that the CC formation is due to recharging of the defects of growth which is characteristic of gallium garnets. The effect of additions, as it has been stated, depends on their type, concentration and has a threshold nature. Various CC models are discussed. 76 refs.; 13 figs.; 6 tabs.

2447 (SAND--88-0344C) Exciton--exciton annihilation in polysilanes. Kepler, R.G.; Zeigler, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-881113—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007934/JAW.

From International topical workshop on advances in silicon-based polymer science; Makaha, HI, USA (21 Nov 1988).

We have measured the exciton--exciton annihilation rate constant for singlet excitons in solid films of poly(n-propyl methyl silane constant was determined by measuring the fluorescent intensity form films as a function of incident light intensity in two types of experiments: one in which the excitons were created by single photon transition and one in which the excitons were created by two photon transitions. The rate constant was found to be about 1 {times} 10/sup {minus}7/cm³s/sup {minus}1/. 14 refs., 2 figs.

2448 (SAND—88-1703C) Rapid e-beam heating for studying metastable transitions in Mn. Follstaedt, D.M.; Knapp, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-881155—3). NTIS, PC A02/MF A01. Order Number DE89000456/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (28 Nov 1988).

We have used rapid heating with a line-source e-beam to determine the temperature of a metastable transition between allotropic phases in Mn. Such transitions are difficult to measure by other experimental means, and often can only be calculated. By heating a deposited layer of the α-phase of Mn on a sapphire substrate with 100 μs e-beam pulses, heating and subsequent cooling rates exceeding 10^6 K/s were achieved. Examining changes in microstructures

after treatment to known (calculable) peak temperatures allows transformation temperatures to be deduced. Manganese was chosen because it has four equilibrium allotropes (with increasing temperature: α, β, γ and δ) and the thermodynamics of its equilibrium transitions are well known, permitting metastable transition temperatures to be calculated. Equilibrium stability ranges for these phases are shown and calculated metastable transitions on the right. Our experiment offers a check on such calculations; with the inferences that γ transforms to β and δ transforms to α during quenching after heating, our results confirm the transition temperature calculated for α to γ. 4 refs., 5 figs.

2449 **(UCRL—99509) Analysis of ion-bombarded and laser-irradiated surfaces of ZnS and Zn via two-photon high-resolution laser-induced fluorescence spectroscopy.** Arlinghaus, H.F.; Calaway, W.F.; Young, C.E.; Pellin, M.J.; Gruen, D.M.; Chase, L.L. (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48;W-31109-ENG-38. 22p. (CONF-881002—9). NTIS, PC A03/MF A01. Order Number DE88017015/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Doppler-shifted two-photon laser-induced fluorescence spectroscopy (LFS) has been used for the first time to measure the velocity distributions of Zn atoms ejected by Ar/sup {plus}/ ion bombardment from both a Zn surface and a ZnS single crystal. Doppler-shifted spectroscopy in combination with time-of-flight, has also been employed to investigate Zn atoms ejected from a ZnS single crystal under irradiation by 308 nm photons (XeCl excimer laser). The absolute Zn sputtering yields from ion-bombarded and laser-irradiated ZnS samples were determined by comparison with LFS measurements of Zn atoms sputtered from pure Zn targets by Ar/sup {plus}/ ions since the absolute sputtering yield is known. For the Zn target the velocity distributions of the ion-induced sputtered Zn atoms were in good agreement with the Sigmund-Thompson distribution based on the known binding energy of 1.35 eV. On the other hand the velocity distribution of Zn atoms ion-sputtered from ZnS showed some deviation from the Sigmund-Thompson distribution and had a lower binding energy, {approximately}0.90 eV. The velocity distributions of the laser-ablated Zn atoms from ZnS were Maxwell-Boltzman in nature with characteristic temperatures increasing from 2000 to 9000 K at fluences of 20 and 80 mJ/cm^2, respectively. The absolute sputtering yield (Y) of Zn sputtered from ZnS was found to be Y {congruent} 8.3 atoms/ion for ion sputtering and Y {congruent} 10/sup {minus}6/ atoms/photon at a laser fluence of 30 mJ/cm^2 for laser ablation. High-resolution Doppler-shift techniques have been combined with TOF techniques. This promising combination permits unambiguous detection of prompt and delayed emission of ablated atoms, as well as the observation of possible molecular or cluster fragmentation. The results obtained indicate that no delayed emission is occurring and suggest the possibility of molecule or cluster emission from ZnS. 52 refs., 6 figs.

2450 **Model for hysteresis in magnetostriction.** Sablik, M.J.; Jiles, D.C. (Southwest Research Institute, P.O. Drawer 28510, San Antonio, Texas 78284). *Journal of Applied Physics;* **64**: No. 10, 5402-5404(15 Nov 1988).

The domain wall pinning model used previously by the authors to explain magnetic hysteresis and stress effects on magnetic hysteresis is used in conjunction with the Callen and Callen expression for magnetostriction λ to qualitatively explain magnetostriction hysteresis both with respect to magnetic intensity H and flux density B. The Callen and Callen form for the magnetostriction is used because it depends functionally on effective field H/sub e/ rather than M, and this produces hysteresis in λ vs B whereas $\lambda = \lambda(M)$ does not. To our knowledge, this is the first time that magnetic hysteresis and magnetostriction hysteresis have been modeled simultaneously.

2451 **Microscopic theory of magnetic excitations in ferromagnets with random anisotropy axes.** Huber, D.L.; Ching, W.Y. (Department of Physics, University of Wisconsin-Madison, Madison, Wisconsin 53706). *Journal of Applied Physics;* **64**: No. 10, 5627-5629(15 Nov 1988).

We present a microscopic theory of the harmonic magnetic excitations in ferromagnets with random anisotropy axes. The theory is analogous to the theory of excitations in spin glasses developed by Walker and Walstedt, with the difference that the disorder arises from the anisotropy rather than the exchange interaction. We report the results of numerical calculations of magnon density of states and the ferromagnetic resonance frequency for a model system where the spins occupy sites on a fcc lattice. The exchange interaction is between nearest neighbors, and the anisotropy axis varies randomly from site to site with no correlation between different sites. Data are obtained with a range of values of the ratio of the anisotropy to the exchange interaction in both the zero-field and high-field limits.

2452 **Ground-state energy of spin-1/2 and spin-1 antiferromagnetic chains: XY model.** Pan, C.Y.; Lin, H.Q. (International Institute of Theoretical Physics, Department of Physics, Utah State University, Logan, Utah 84322). *Journal of Applied Physics;* **64**: No. 10, 5932-5934(15 Nov 1988).

The ground-state energy of the XY antiferromagnetic chains with spin-1/2 and spin-1 are obtained by a real space renormalization group method. For $S = 1/2$ a large spin cluster is used in the mapping to improve the accuracy and a boundary theory is applied to extrapolate to the result which is in excellent agreement with the exact Bethe Ansatz result. For $S = 1$ the ground-state energy of the model is obtained by using the renormalization group method and a finite chain calculation for lattices up to 16 sites. The two results are in very good agreement.

2453 **Electronic structure of metal-electrolyte surfaces: Three-dimensional calculation.** Price, D.L.; Halley, J.W. (Department of Physics, West Virginia University, P.O. Box 6023, Morgantown, West Virginia 26506-6023). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9357-9367(15 Nov 1988).

We improve upon a theory presented earlier for the response of a metal-electrolyte surface to applied voltage. The new calculation is three dimensional, using a local-density, repeated-slab model of a jellium surface in contact with a monolayer of a model solvent. The ground state of this system is obtained for a range of jellium-solvent distances and for a range of induced surface charge densities. The results are used to examine the charge dependence of the metal-solvent distance, the distribution of charge induced on the metal, and to extract a rough prediction for the differential capacitance of a metal-electrolyte interface as a function of charge.

2454 **Dynamical simulations of stress, strain, and finite deformations.** Ribarsky, M.W.; Landman, U. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9522-9537(15 Nov 1988).

Formulations and methodologies of molecular-dynamics simulations of material systems evolving under applied finite external perturbations are developed and discussed. Focusing on interfacial systems, composed of interfacing crystalline solids characterized by differing interatomic interactions and atomic sizes, the mechanisms and dynamics of response and stress relief in the elastic, plastic, and inelastic regimes are investigated. Critical values of the external perturbations (stress and strain) are determined, showing dependence on the nature of the interface and the ambient conditions (thermally adiabatic versus isothermal).

2455 **Modeling and interpretation of tweed microstructures in face-centered-cubic solids.** Silberstein, A.; Clapp, P.C. (Department of Metallurgy and Institute of Materials Science, University of Connecticut, Storrs, Connecticut 06268). *Physical Review [Section] B: Condensed Matter;* **38**: No. 14, 9555-9566(15 Nov 1988).

Using molecular-dynamics simulations and an interatomic potential that had been designed to be unstable to $<110>\{11\text{-bar}0\}$ shears, we studied the mechanisms of tweed formation in face-centered-cubic (fcc) crystals. We found that tweed is most probably a premartensitic phenomenon that nucleates homogeneously in strongly anharmonic solids. Yet tetragonal strain fields will enhance the formation of tweed in the crystal. Unlike the case of body-centered-cubic (bcc) crystals, we did not find any particular feature in the interatomic potential that is common to all materials showing a

tweed instability. Finally, we showed that solitons with hyperbolic-tangent strain fields are the kind of elastic shear waves that propagate in such anharmonic solids.

2456 **Real time Monte Carlo simulation of thin film nucleation in localized-laser chemical vapor deposition.** Kotecki, D.E.; Herman, I.P. (Physics Department, Lawrence Livermore National Laboratory, Livermore, California 94550 and Department of Applied Science, University of California, Davis/Livermore, California 94550). *Journal of Applied Physics;* **64**: No. 10, 4920-4942(15 Nov 1988).

A real time Monte Carlo simulation is used to model the nucleation and initial stages of thin film growth during localized-laser chemical vapor deposition (LLCVD). This model includes the effects of laser—substrate heating, heterogeneous pyrolytic decomposition of parent molecules on the laser-heated region of the surface, and adatom migration and desorption dynamics. The amount of material deposited as a function of time is obtained over a surface area of 150 x 150 A for various values of the substrate temperature, parent gas pressure, and adsorbate—substrate binding energy. Additional information is obtained about the cluster density, and the role of surface defects and two-atom cluster dynamics on the initial growth rate. The deposition of silicon by heterogeneous pyrolytic decomposition of silane (SiH_4) is used as a base case for the simulation. Predictions of the initial thin film morphology and its temporal evolution during static laser heating of micron-dimensional regions of the surface are presented. Simulation results indicate that for a given silane pressure and adsorbate—substrate binding energy, there is a critical temperature T/sub c/ such that for laser-induced peak temperatures T/sub p/<T/sub c/, nucleation initiates at the center of the laser-heated region, while for T/sub p/>T/sub c/, nucleation occurs initially in an annulus region centered with respect to the incident laser irradiation. The inclusion of two-atom cluster dynamics in the simulation is shown to increase the value of T/sub c/ and alter the initial morphology for low adsorbate—substrate binding energies.

2457 **Development of spatial correlations during diffusional late-stage phase transformations in stressed solids.** Voorhees, P.W.; Johnson, W.C. (Department of Materials Science and Engineering, Northwestern University, Evanston, Illinois 60208). *Physical Review Letters;* **61**: No. 19, 2225-2228(7 Nov 1988).

We examine the dynamics of the development of interparticle spatial correlations during the later stages of a first-order phase transformation in which the second-phase particles generate a stress field. Through an analysis of the diffusional and elastic interactions between two particles, it is shown that the long-ranged motion of the centers of mass of the particles within the solid is an important component in the development of the experimentally observed spatial correlations.

2458 **X-ray fluorescence of layered synthetic materials with interfacial roughness.** Krol, A.; Sher, C.J.; Kao, Y.H. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794-3800). *Physical Review [Section] B: Condensed Matter;* **38**: No. 13, 8579-8592(1 Nov 1988).

Measurements of x-ray fluorescence versus grazing incidence angle at fixed incoming photon energy can provide useful information on surface and interfacial microstructure. A matrix formulation suitable for analysis of radiant energy flow inside a layered material, and hence angular fluorescence emission, is presented, and a vector scattering model is employed to account for the effect of interfacial roughness. Good agreement between experimental results of x-ray fluorescence yield and the model calculations has been obtained in a semiconductor heterostructure and a superlattice system.

2459 **Theoretical investigation of possible low-lying electronic excitations in $YBa_2Cu_3O_7$/sub -//sub x/.** Curtiss, L.A.; Tam, S.W. (Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439-4837). *Journal of Materials Research;* **3**: No. 6, 1269-1272(Nov 1988).

Ab initio molecular orbital calculations of oxygen 2p hole states of small CuO clusters representing the chains and planes in $YBa_2Cu_3O_7$/sub -//sub x/ are reported. The results suggest that the absorption observed at 0.37 eV in reflectivity studies of $YBa_2Cu_3O_7$/sub -//sub x/ may be due to excitation of these holes between inequivalent oxygen sites.

2460 **Study of point defects in alkaline-earth sulfides.** Pandey, R.; Kunz, A.B.; Vail, J.M. (Physics Department, Michigan Technological University, Houghton, Michigan 49931). *Journal of Materials Research;* **3**: No. 6, 1362-1366(Nov 1988).

The results of a computer simulation study of point defects including vacancy, interstitial, and F^+ center in alkaline-earth sulfides are presented. The study is based on ICECAP/HADES simulation procedures and uses empirical interionic potentials obtained from the analysis of macroscopic data for these materials. The results predict the dominance of Schottky disorder and suggest that vacancy migration predominates in alkaline-earth sulfides. Furthermore, the calculated F^+ center absorption energy is in good agreement with the experimental data deduced from the optical stimulated studies in these materials.

2461 **Equation of state of dense helium.** LeSar, R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **61**: No. 18, 2121-2124(31 Oct 1988).

Comparison between pressure-volume relations in helium at high pressures indicates that theoretical calculations based on gas-phase pair potentials are not adequate to explain recent x-ray experiments. Regardless of what potential is used, the gas-phase potentials give an equation of state that is much too stiff. We show that if the changes in the atomic wave functions induced by the high-pressure crystal environment are taken into account, then agreement between experimental and theoretical pressure-volume curves is greatly improved.

6561 Superconductivity

REFER ALSO TO CITATION(S) 1038, 1040, 1042, 1255, 2425, 2459

2462 **(AD-A—195545/9/XAB) Combined effect of Zener and quasi-particle transitions on the dynamics of mesoscopic Josephson junctions.** Mullen, K.; Ben-Jacob, E. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 14 Mar 1988. 5p. NTIS, PC A02/MF A01.

Pub. in Physical Review Letters, Vol. 60, No. 11, 1097-1100(14 Mar 1988).

Ultrasmall Josephson junctions were studied, using the coherent picture to describe the pair dynamics and the semiclassical approach for the quasi particles. It was found that the dynamics depends crucially on the ratio of the superconducting gap energy delta(T) to the charging energy sq e/2C. The pair 'Block oscillations' can be practically observed when 2delta(T)>sq e/2C; for 2delta(T)<sq e/2C the Idc/e oscillations due to quasi-particle tunneling can be observed. Conditions under which the I-V characteristic will be S-shaped, exhibiting both oscillations at different values of the current are discussed.

2463 **(AD-A—195647/3/XAB) Theory of superconductivity in oxides. Final technical report.** Anderson, P.W. (Princeton Univ., NJ (USA). Dept. of Physics). 18 May 1988. 4p. NTIS, PC A02/MF A01.

Progress was made towards a final theory of high-Tc superconductivity. The key elements are the work on normal-state properties and the actual mechanism for Tc. With the understanding (ZA) of the large anisotropy and other transport properties in the normal state, the model is uniquely determined: one must have one version or another of a holon-spinon quantum-fluid state, which is not a normal Fermi liquid. And with the recognition (HWA) of the large-repulsion holon-holon interactions, the author has the first way of thinking quantitatively about the superconducting state. Work on the pure Heisenberg system, which is related but not necessarily crucial to understanding the superconducting properties is described.

2464 **(DOE/ER/45214—T2) Twin boundaries and heterophase interfaces in ferroelastic martensites: Final report, July 1, 1985--June 30, 1988.** Barsch, G.R. (Pennsylvania State Univ., University Park (USA). Materials Research Lab.). 30 Sep 1988. Contract FG02-85ER45214. 13p. NTIS, PC A03/MF A01. Order Number DE89001568/JAW.

A comprehensive theoretical study with concurrent supporting experimental investigations has been started on coherent and semicoherent interfaces in ferroelastic martensites, including twin boundaries and twin bands, heterophase parent/product interfaces and inclusions, and transformation precursors. This work is motivated by the need for understanding the relation between bulk properties and domain configurations, and the nature of transformation precursors and their role in the martensite nucleation mechanism. The theory is based on a nonlinear, nonlocal anisotropic elastic continuum model for proper FE martensites which can be used to calculate the twin boundary energy and strain profile as well as the pretransformation strain modulation from second and higher order elastic constants and from phonon dispersion data. Furthermore, we have calculated the strain energy associated with habit plane interfaces and studied the dynamical properties of twin boundaries and their effect on the specific heat and on the superconducting transition temperature. Based on our theoretical results, we have also proposed a heuristic model for martensite formation which involves the pretransformation modulation as intermediate step and would require only less potent defects for heterogeneous nucleation than according to the prevailing view. 15 refs.

2465 **(INIS-BR—1286) Superconductivity: actual stage forcasting and subsidies for national policy.** Morato, S.P. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1987. 55p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704529/JAW.

An overview on the situation of metallic superconductors, their applications and market, and a brief history about the superconductivity at high T/sub c/ (new ceramic superconductors), describing the actual level of research and development in the world and national plans are presented. Some comments about incentives and markets for rare earths are done. The scientific and technological challengers are discussed and some suggestions to lead a superconductivity national program are proposed. (M.C.K.).

2466 **(LBL—25795) Magnetic conditioning in superfluid.** Caspi, S. (Lawrence Berkeley Lab., CA (USA)). Aug 1988. Contract AC03-76SF00098. 8p. (CONF-8808143—1). NTIS, PC A02/MF A01. Order Number DE89000550/JAW.

From Japan-U.S. seminar on basic mechanisms of helium heat transfer and related influence on stability of superconducting magnets; Fukuoka, Japan (29 Aug 1988).

Improvements in superconducting magnet technology have reduced to a handful the number of training quenches typical of dipole magnets. The number of training quenches in long (17 m) and short (1--2 m) SSC magnets are now about the same (operating at 6.6 tesla and 4.4 K). Yet the steps necessary to totally eliminate training are in the future R&D plans for magnet construction and conductor motion prevention. The accepted hypothesis is that Lorentz forces and poor mechanical properties of superconducting cables are the cause of conductor motion. Conductor motion reduces the stored energy in the cable by converting it into heat. The small amount of heat generated (millijoules) during motion is usually enough to quench the magnet when it is close to short sample. During training, the magnet performance normally improves with the number of quenches. It is not the quench itself that improves magnet performance but rather the fact that once conductor motion has occurred it will probably not repeat itself unless subjected to higher forces. Conditioning is a process that enables the magnet to reduce its stored energy without causing a premature quench. During the conditioning process the magnet is further cooled from its operating temperature of 4.4 K to 1.8 K by converting He I into He II. As a result the magnet is placed in a state where it has excess stability as well as excellent heat transfer capabilities. Although this does not eliminate motion, if the magnet is now cycled to {approximately}10% above its operating field at 4.4 K (which is above short sample) the excess stability should be enough to prevent quenching and reduce the probability of conductor motion and training once the magnet has been warmed back up to its operating temperature of 4.4 K. 3 refs., 5 figs.

2467 **Candidate muon-probe sites in oxide superconductors.** Dawson, W.K.; Tibbs, K.; Weathersby, S.P.; Boekema, C.; Chan, K.B. (Department of Physics, San Jose State University, San Jose, California 95192). *Journal of Applied Physics;* **64**: No. 10, 5809-5811(15 Nov 1988).

Two independent search methods (potential-energy and magnetic-dipole-field calculations) are used to determine muon stop sites in the RBa_2Cu_3O/sub x/ (x≅7) superconductors. Possible sites, located about 1 A away from oxygen ions, have been found and are prime candidates as muon-probe locations. The results are discussed in light of existing muon-spin-relaxation (μSR) data of these exciting oxides, and compared to H- and positron-oxide superconductor studies. Further work is in progress to establish in detail the muon-probe sites; this knowledge is an essential ingredient for a correct interpretation of μSR data of high-temperature superconducting oxides.

2468 **Effective strong-coupling Hamiltonians for bipolaron centers and magnetic impurities with on-site electron-phonon coupling.** Schuettler, H.; Fedro, A.J. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 13, 9063-9068(1 Nov 1988).

We have studied a model of bipolaron (negative-U) centers and magnetic impurities which includes a repulsive on-site Coulomb interaction as well as a coupling of the electronic on-site energy to the displacement amplitude of a local phonon mode. By means of a generalized Schrieffer-Wolff transformation, we derive an effective strong-coupling (or weak-hybridization) Hamiltonian for the low-lying states of the system. In the case of a bipolaron center (where the phonon-mediated on-site attraction dominates over the Coulomb repulsion), the effective Hamiltonian describes conduction-electron scattering and electron-pair tunneling processes between the localized impurity orbital and the conduction band of the metallic host. In the limit of very strong electron-phonon coupling, the pair tunneling matrix elements become exponentially small, whereas conduction electron scattering is suppressed only algebraically. The impurity orbital occupation number is then almost "frozen in" and the bipolaron center becomes inefficient in enhancing the superconducting pairing correlations of the host. In the case of a magnetic impurity (with a predominant repulsive Coulomb interaction), the effective Hamiltonian reduces to the form of an ordinary Kondo spin-exchange model. The spin-exchange coupling constants are not affected by the presence of the electron-phonon interaction.

2469 **Dynamics of a fluxon in a long Josephson junction with a periodic lattice of inhomogeneities.** Malomed, B.A. (P. P. Shirshov Institute for Oceanology of the U.S.S.R. Academy of Sciences, 23 Krasikov Street, Moscow, 117218, Union of Soviet Socialist Republics). *Physical Review* [*Section*] *B: Condensed Matter;* **38**: No. 13, 9242-9244(1 Nov 1988).

A model of a damped dc-driven long Josephson junction (LJJ) with periodically installed microresistors or microshorts (microshunts), or crossed by a periodic chain of Abrikosov vortices, is considered. A maximum value of the bias current density admitting pinned states of a fluxon and a minimum value admitting free motion of fluxon are found, the latter being an important generalization of the well-known result of McLaughlin and Scott. For LJJ's with a sinusoidal profile of the inhomogeneity, a current-voltage characteristic is obtained in an explicit form.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 1214, 2043, 2675

2470 **(EFI—982(32)-87) Charged particle motion in the field of a plane electromagnetic wave in vacuum.** Babakhanyan, Eh.A.; Musakhanyan, V.V. (Erevanskij Fizicheskij Inst. (USSR); AN Armyanskoj SSR, Ashtarak. Inst. Fizicheskikh Issledovanij). (Erevanskij Fizicheskij Inst. (USSR)). 1987. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704425/JAW.

Within the frameworks of classical electrodynamics the motion of a relativistic charged particle in the field of the plane electromagnetic wave in vacuum is considered with the use of initial values for the particle's coordinate and momentum. The physical consequences are discussed and the connection between the obtained solution and those known in the literature is shown. 2 refs.

2471 **(EFI—983(33)-87) On the establishment of thermal equilibrium in simplest mechanical systems.** Kotsinyan, Ar.M. (Erevanskij Fizicheskij Inst. (USSR)). 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704426/JAW.

The process of the establishment of thermal equilibrium of the damping oscillators and a "free" particle in interaction with the blackbody radiation field is considered. A special attention is payed to the principal role of non-closedness of real systems as well as to the irreversibility of the microscopic equations of motion in the question of grounding of the statistical physics. 8 refs.

2472 **(IAE—4594/1) Unified geometrical gravitation and electromagnetism theory. 2. Ultraweak gravitational electromagnetic and scalar fields.** Bryushinkin, S.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1988. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704454/JAW.

The six-dimensional Kaluza theory was considered, which contains superweak scalar, electromagnetic and gravitational fields in additon to usual gravitational and electromagntic ones. The central symmetrical solution was obtained which apart from a usual electric includes a superweak electric charge. The hypothesis explaining the existence of two pulses of neutrino from a supernova SN 1987A was suggested. In the considered theory the electron neutrino is identified within a classical limit with the central symmetrical solution with a superweak charge. 7 refs.

2473 **(IFVE-OTF—87-164) Special relativity theory and experiments at centrifuge.** Chugreev, Yu.V.; Logunov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704503/JAW.

The paper considers a number of possible experiments to be performed at a centrifuge with a view to test Special Relativity Theory. The notions of observer's proper time, distances and frequencies, etc. measured physically are discussed. 9 refs.

2474 **(IFVE-OTF—88-36) Gauge invariance and constraints.** Pyatov, P.N.; Razumov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 20p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704508/JAW.

The constraints, which arise in the Hamiltonian description of a wide class of gauge invariant Lagrangian system, are shown to be of first class. An explicit expression for the Poisson brackets of Hamiltonian and constraints has been obtained. 13 refs.

2475 **(IFVE-OTF—88-39) New continual analogs of two-dimensional Toda lattices related with nonlinear integro-differential equations.** Savel'ev, M.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1988. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704509/JAW.

Continual "extensions" of two-dimensional Toda lattices are proposed. They are described by integro-differential equations, generally speaking, with singular kernels, depending on new (third) variable. The problem of their integrability on the corresponding class of the initial discrete system solutions is discussed. The latter takes place, in particular, for the kernel coinciding with the causal function. 5 refs.

2476 **(INFN/AE—85-6) Tachyon kinematics and causality. A systematic thorough analysis.** Recami, E. (Istituto Nazionale di Fisica Nucleare, Catania, Italy). (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). 1985. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780143/JAW.

The chronological order of the events along a space-like path is not invariant under Lorentz transformations, as well-known. This led to an early conviction that tachyons would give rise to causal anomalies. A relativistic version of the Stuckelberg-Feynman Switching procedure (SWP) has been invoked as the suitable tool to eliminate those anomalies. The application of the SWP does eliminate the motions backwards in time, but interchanges the roles of source and detector. This fact triggered the proposal of a host of causal paradoxes. Till now, however, it has not been recognized that such paradoxes can be sensibly discussed (and completely solved, at least in microphysics) only after having properly developed the tachyon relativistic mechanics. We start by showing how to apply the SWP, both in the case of ordinary Special Relativity, and in the case with tachyons. Then, we carefully exploit the kinematics of the tachyon- exchange between to (ordinary) bodies. Being finally able to tackle the tachyon- causality problem, were successively solve the paradoxes: (i) by Tolman-Regge; (ii) by Pirani; (iii) by Edmonds; (iv) by Bell. At least, we discuss a further, new paradox associated with the transmission of signals by modulated tachyon beams. 111 refs.

2477 **(INIS-BR—1285) Dynamic of exact perturbations in Bianchi IX type cosmological models.** Mello Neto, J.R.T. de. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1985. 125p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88704528/JAW.

The dynamic of Bianchi IX type cosmological models is studied, after reducing Einstein equations to Hamiltonian system. Using the Melnikov method, the existence of chaos in the dynamic of these models is proved, and some numerical experiments are carried out. (M.C.K.).

2478 **(ITEP—32(1988)) Some examples of instantons in sigma models. 2. K3 manifolds.** Kogan, Ya.; Markushevich, D.; Morozov, A.; Ol'shanetskya, M.; Perelomov, A.; Roslij, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1988. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704583/JAW.

Instantons on some manifolds of type K3 are described. Zero modes in two-dimensional sigma models on such manifolds are counted. The necessary facts on K3 manifolds are exposed in monographs. Instanton configurations are described. 12 refs.; 19 figs.

2479 **(JINR-E—2-87-826) On dynamic equations for interaction of the affinor field with affine connection.** Pestov, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704604/JAW.

Submitted to the 21. Intern. Symp. Element. Part. Theory, GDR, 1987.

The Lagrangian of interaction of an affinor field with an affine connection is constructed and the equations of motion and conservation laws are derived. It is shown that there exists a symmetric conserved tensor of the affine-connection energy-momentum. 7 refs.

2480 **(JINR-E—5-87-902) Asymptotic behaviour of the regular solution of three-particle integrodifferential equations in the vicinity of the triple collision point.** Pupyshev, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704619/JAW.

Submitted to the journal Theor. Math. Phys. .

It is shown that any regular solution of three-particle integrodifferential equations may be represented in the vicinity of the

triple collision point as a double sum containing the hyperradius powers, its logarithm powers and unknown functions of a single hyperspherical angle. The recurrent integrodifferential equations are obtained for those functions in the case of spherically symmetric potentials. 12 refs.

2481 **(JINR-R—2-87-877) Relativistic length in high energy physics.** Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704631/JAW.

The role of relativistic length of high physics is discussed. Some approaches applied to description of experimental data on particle interaction at high energies is considered. Among them here are parton, reggeon, string models of elementary particles and hydrodynamical theory of multiple processes. It is noted that these approaches are closely connected with a concept of relativistic length and proceeding from this "elongation formula". In particular, on the base of this concept the solution of the known difficulty of hydrodynamical theory which contradicts the uncertainty principle is given. On the basis of elementary particle finiteness the connection of formation length with the relativistic length is established. It is noted that the linear increase of longitudinal distances with growing Lorentz-factor corresponds to the results of experiments on the study of the effect of motion on space dimensions of identical pion generation region. The obtained in these experiments indication to the increase in corresponding longitudinal dimensions as a result coul be considered as the most direct evidence in favor of relativistic "elongation formula". 29 refs.; 3 figs.

2482 **(JINR-R—2-87-910) Spectroscopy of a one-dimensional hydrogen atom.** Lutsenko, I.V.; Mardoyan, L.G.; Pogosyan, G.S.; Ter-Antonyan, V.N.; Sisakyan, A.N. (Erevanskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704633/JAW.

Submitted to the journal J. Phys. A.

One-dimensional parabolic coordinates are introduced by a method similar to that of separation of variables in partial differential equations and an explicit form is established for an extra constant of motion analogous with the Runge-Lenz vector and responsible for the double generation of excited energy levels in a one-dimensional hydrogen atom. 11 refs.; 1 fig.

2483 **(JINR-R—2-88-27) Imbedding of the gravitational field into the space of affine connection without torsion.** Chernikov, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1988. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704637/JAW.

Submitted to the Organizing Committee of the Workshop Gravitation and Electromagnetism, Minsk, 1987.

Mathematical meaning of the energy-momentum pseudoscalar is exactly determined in the general relativity: this geometrical object is a tensor functional of the background connection. Affine connection of that type was first considered in 1940 by Rosen who imbedded the gravitational field into the Minkowski world. The background connection then appeared in a primitive form: it had neither curvature, nor torsion. In our case the background connection acquires an arbitrary curvature so that the gravitational field is imbedded into an arbitrary space of the affine connection without torsion. Variational derivatives of the action function is taken both with respect to the basic metric tensor and the background connection. The result is a new identity whose particular case is the known identity for the Einstein tensor. If the background connection is considered Christofel, the known Papapetrou results follow in a generalized form. If now we equate the variational derivative with respect to the basic tensor, to zero, we obtain the form of equations for the gravitational fiel on the background of affine connection without torsion. 10 refs.

2484 **(JINR-R—17-87-176) Superradiance.** Bogolyubov, N.N. Jr.; Shumovskij, A.S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1987. 88p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704660/JAW.

The book represents a course of lectures delivered by the authors in JINR in the ehd of 1985 - bedinning of 1986. It contains basic physical principles, related with the problem of superradiance, formation of model problems, a review of results on studying equilibrium solutions, regular presentation of dynamic theory. The book is based, in great part, on original results obtained by the authors, who offered a series of a new model problems in superradiance theory and developed methods of investigating equilibrium and dynamic characteristics of superradiant systems. 136 refs.; 25 figs.

2485 **(JINR-R—17-87-645) Superradiance in a system with external sources.** Bogolyubov, N.N. Jr.; Shumovskij, A.S.; Kudryavtsev, I.K.; Lyagushin, S.F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Moskovskij Gosudarstvennyj Univ. (USSR)). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88704661/JAW.

Submitted to the journal Physica.

The influence of the classical external field and classical current on the character of dynamic process in the superfluorescent system is investigated. It is shown that constant current does not affect the characteristics of superfluorescent pulse. The effect of 'locking' of residual population by the external field is described. The dependence of the pulse delay time on the external field parameters is studied. 7 refs.; 3 figs.

2486 **(LAFI—112) Class of periodic solutions of nonlinear wave and evolution equations.** Kashcheev, V.N. (AN Latvijskoj SSR, Riga. Inst. Fiziki). 1987. 29p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704666/JAW.

For the case of $1+1$ dimensions a new heuristic method is proposed for deriving dels-similar solutions to nonlinear autonomous differential equations. If the differential function f is a polynomial, then: (i) in the case of even derivatives in f the solution is the ratio of two polynomials from the Weierstrass elliptic functions; (ii) in the case of any order derivatives in f the solution is the ratio of two polynomials from simple exponents. Numerous examples are given constructing such periodic solutions to the wave and evolution equations. 50 refs.

2487 **(LLL/M—190-Vol.2) Associated Western Universities summer graphics project: Volume 2, Electromagnetism.** Miller, E.K.; Cole, R.W. (eds.). (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 187p. NTIS, PC A09/MF A01. Order Number DE89001556/JAW.

This document is a collection of texts to accompany computer-animated movies that were developed during the summers of 1984-1986 at Lawrence Livermore National Laboratory by faculty member$ visiting from six universities./sup asterisk/ The project entitled "Computer & Computer Graphic Applications in Engineering Education" was funded by The American Western Universities, Inc., and the US Department of Energy. The goal of the project is to promote the use of computers and computer graphics in science and engineering education through the development of software for interactive modeling and graphical display of appropriate problems and the production of computer-generated films for displaying physical phenomena. The project brings together physics and engineering faculty to produce computer-animated videotapes of ideas and processes that are very difficult to describe in lecture, but would benefit greatly from an animated representation. Examples are given in Electromagnetism.

2488 **(LLL/M—190-Vol.3) Associated Western Universities summer graphics project: Volume 3, Optics.** Miller, E.K.; Cole, R.W. (eds.). (Lawrence Livermore National Lab., CA (USA)). Aug 1988. Contract W-7405-ENG-48. 34p. NTIS, PC A03/MF A01. Order Number DE89001557/JAW.

This document is a collection of texts to accompany computer-animated movies that were developed during the summers of 1984-1986 at Lawrence Livermore National Laboratory by faculty

members visiting from six universities. The project entitled "Computer & Computer Graphic Applications in Engineering Education" was funded by The American Western Universities, Inc., and the US Department of Energy. The goal of the project is to promote the use of computers and computer graphics in science and engineering education through the development of software for interactive modeling and graphical display of appropriate problems and the production of computer-generated films for displaying physical phenomena. The project brings together physics and engineering faculty to produce computer-animated videotapes of ideas and processes that are very difficult to describe in lecture, but would benefit greatly from an animated representation. Examples are given in Optics.

2489 **(N—88-26157) Semi-discrete approximations to nonlinear systems of conservation laws; consistency and L(infinity)-stability imply convergence. Final report.** Tadmor, E. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jul 1988. 63p. (NASA-CR—181683; ICASE—88-41; NAS—1.26:181683). NTIS, PC A04/MF A01.

A convergence theory for semi-discrete approximations to nonlinear systems of conservation laws is developed. It is shown, by a series of scalar counter-examples, that consistency with the conservation law alone does not guarantee convergence. Instead, a notion of consistency which takes into account both the conservation law and its augmenting entropy condition is introduced. In this context it is concluded that consistency and L(infinity)-stability guarantee for a relevant class of admissible entropy functions, that their entropy production rate belongs to a compact subset of H(loc)sup -1 (x,t). One can now use compensated compactness arguments in order to turn this conclusion into a convergence proof. The current state of the art for these arguments includes the scalar and a wide class of 2 x 2 systems of conservation laws. The general framework of the vanishing viscosity method is studied as an effective way to meet the consistency and L(infinity)-stability requirements. How this method is utilized to enforce consistency and stability for scalar conservation laws is shown. In this context we prove, under the appropriate assumptions, the convergence of finite difference approximations (e.g., the high resolution TVD and UNO methods), finite element approximations (e.g., the Streamline-Diffusion methods) and spectral and pseudospectral approximations (e.g., the Spectral Viscosity methods).

2490 **(SAND—88-1116) Sommerfeld integrals and electromagnetic fields.** Caffey, T.W.H. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DP00789. 64p. NTIS, PC A04/MF A01. Order Number DE89001841/JAW.

The complete electromagnetic fields for both elementary electric and magnetic dipoles are listed for both horizontal and vertical orientations of the dipoles. All combinations of dipole and field point locations above or below the boundary between two conducting half-spaces are included. 10 refs.

2491 **Use of time space Green's functions in the computation of transient eddy current fields.** Davey, K.; Turner, L. (School of Electrical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332-0250). *Journal of Applied Physics;* **64**: No. 11, 6132-6137(1 Dec 1988).

The utility of integral equations to solve eddy current problems has been borne out by numerous computations in the past few years, principally in sinusoidal steady-state problems. This paper attempts to examine the applicability of the integral approaches in both time and space for the more generic transient problem. The basic formulation for the time space Green's function approach is laid out. A technique employing Gauss-Laguerre integration is employed to realize the temporal solution, while Gauss—Legendre integration is used to resolve the spatial field character. The technique is then applied to the fusion electromagnetic induction experiments (FELIX) cylinder experiments in both two and three dimensions. It is found that quite accurate solutions can be obtained using rather coarse time steps and very few unknowns; the three-dimensional field solution worked out in this context used basically only four unknowns. The solution appears to be somewhat sensitive to the choice of time step, a consequence of a numerical instability imbedded in the Green's function near the origin.

2492 **Series analysis of multivalued functions.** Baker G.A. Jr.; Oitmaa, J.; Velgakis, M.J. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 10, 5316-5331(15 Nov 1988).

A recurrent problem in mathematical physics, for example, in the theory of critical phenomena, is the need to study the structure of physically interesting functions at a branch point of a complex structure usually called a "confluent singularity." In such a neighborhood the function is necessarily multivalued. In addition, the value of such a function is sometimes required on a branch cut or even off the first Riemann sheet. Our approach to this problem is inspired by the Riemann (global) monodromy theorem and consists of using series expansions to form integral approximants (special case of Hermite-Pade approximants) to represent multivalued functions on multiple Riemann sheets. We prove an analogous local-monodromy-theorem, functional-representation results. We further identify the important "separation property" and use it to prove a convergence theorem for horizontal sequences of integral approximants. We make an extensive numerical investigation, using horizontal, diagonal, and constrained diagonal sequences, and find that these methods give excellent results on a wide variety of test functions of rather complex structure.

2493 **Driven Morse oscillator: Classical chaos and quantum theory for two-frequency excitation.** Goggin, M.E.; Milonni, P.W. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **38**: No. 10, 5174-5181(15 Nov 1988).

We extend our previous comparison of classical and quantum theories for the excitation and dissociation of a sinusoidally driven Morse oscillator [Phys. Rev. A 37, 796 (1988)] to the case of two-frequency driving. In both the classical and quantum theories the total threshold intensity for dissociation can be considerably smaller in the two-frequency case. This is consistent with results obtained with more artificial models of laser-driven molecular systems, and we provide an approximate resonance-overlap analysis to explain this trend. We also compare results obtained with adiabatic and sudden turn-on of the applied field, and comment on the use of absorbing boundaries for the computational identification of dissociation or ionization.

2494 **Cyclic evolution in quantum mechanics and the phases of Bohr-Sommerfeld and Maslov.** Littlejohn, R.G. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* **61**: No. 19, 2159-2162(7 Nov 1988).

The Bohr-Sommerfeld and Maslov phases, which occur in the Einstein-Brillouin-Keller quantization rule of semiclassical mechanics, are shown to be examples of Berry's phase. The generalization of Berry's phase due to Aharanov and Anandan, which does not require adiabaticity, is employed.

2495 **Ander et al. reply.** Ander, M.E.; Goldman, T.; Hughes, R.J.; Nieto, M.M. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review Letters;* **61**: No. 19, 2273-2273(7 Nov 1988).

Recently we proposed a possible resolution of the Brookhaven and Washington Eotvos experiments. This resolution involved the use of our two-component (graviphoton-graviscalar) model of new gravitational forces to model the large-scale diabase sill at the palisades site. In this analysis we used the ranges of our parameters d and δ which were allowed by an earlier analysis. This comment is in response to a comment regarding possible correlation constraints on the allowed values of d and δ. (AIP)

2496 **Geometric angles in cyclic evolutions of a classical system.** Bhattacharjee, A.; Sen, T. (Department of Applied Physics, Columbia University, New York, New York 10027). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4389-4394(1 Nov 1988).

A perturbative method, using Lie transforms, is given for calculating the Hannay angle for slow, cyclic evolutions of a classi-

cal system, taking into account the finite rate of change of the Hamiltonian. The method is applied to the generalized harmonic oscillator. The classical Aharonov-Anandan angle is also calculated. The interpretational ambiguity in the definitions of geometrical angles is discussed.

2497 **Light scattering by an arbitrary particle: the scattering-order formulation of the coupled-dipole method.** Singham, S.B.; Bohren, C.F. (Life Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of the Optical Society of America A: Optics and Image Science;* **5**: No. 11, 1867-1872(Nov 1988).

The field scattered by an arbitrary particle modeled as an array of coupled dipoles can be expressed as an infinite series in terms of scattering orders. The fields of a given scattering order can be calculated from those of the previous order. When the series converge, the approximate method agrees well with the exact theory for a sphere. The maximum size of the dipolar array that can be used with the method as well as the number of terms required for convergence depends on the relative refractive index and the shape of the particle.

2498 **Ban/sup TM/ deodorant ball mortar.** Jr., D.R.C.; Rehbein, D.J.; Bonometti, R.J. (Virginia Military Institute, Lexington, VA 24450). *Physics Teacher;* **26**: No. 8, 522-524(Nov 1988).

The kinematics are discussed for the demonstration of two balls dropped simultaneously one on top of another. (AIP)

70 FUSION ENERGY

REFER ALSO TO CITATION(S) 2429, 2656

2499 **(ACIESP—60-Vol.1) Proceedings of the 6. Japan-Brazil Symposium on Science and Technology.** (Academia de Ciencias do Estado de Sao Paulo (Brazil)). 1988. 152p. (CONF-8808156—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW.

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

Researches carried out on: applications of radiation and radioisotopes; ceramics; environment; metals and alloys; nuclear safety; radiation protection; plasma; and space science, are presented. (M.C.K.).

2500 **(EUR—11579-EN) JET Joint Undertaking. Progress report 1987.** Keen, B.E. (ed.). (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). Mar 1988. 566p. (EUR-JET-PR—5). NTIS (US Sales Only), PC A24/MF A01. Order Number DE88755240/JAW.

The paper is a JET progress report 1987, and covers the fourth full year of JET's operation. The report contains an overview summary of the scientific and technical advances during the year, and is supplemented by appendices of detailed contributions of the more important JET articles published during 1987. The document is aimed at specialists and experts engaged in nuclear fusion and plasma physics, as well as the general scientific community. (U.K.).

7001 Plasma Research

REFER ALSO TO CITATION(S) 625, 1312, 2065, 2113, 2573, 2590, 2600, 2626, 2627

2501 (ACIESP—60-Vol.1, pp 57) **Some applications of RF-fields to plasmas.** Sato, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2502 (ACIESP—60-Vol.1, pp 61) **Critical power for rf current drive.** Assis, A.S. de; Busnardo Neto, J. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2503 (ACIESP—60-Vol.1, pp 62) **Propagation and absorption of waves in the lower hybrid frequency range in small aspect ratio tokamak plasma.** Montes, A.; Leite, J.P.; Shibata, C.S. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2504 (ACIESP—60-Vol.1, pp 63) **Design of a high power 356H/sub z/ gyrotron.** Barroso, J.J.; Castro, P.J. de; Correa, R.A.; Galvao, G.P.; Ludwig, G.O.; Montes, A.; Nono, M.C.A.; Rossi, J.O. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2505 (ACIESP—60-Vol.1, pp 64) **Quasi-linear electron cyclotron absorption in a slab model for TBR-2.** Ziebell, L.F. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2506 (ACIESP—60-Vol.1, pp 74) **Experimental investigations on discharge plasmas.** Maciel, H.S.; Amorim Filho, J. de; Motta, C.C.; Sudano, J.P. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. Tecnologico de Aeronautica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2507 (ACIESP—60-Vol.1, pp 60) **Electron density measurements in the center of TBR-1 tokamak.** Silva, R.P. da; Nascimento, I.C. do. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2508 (ACIESP—60-Vol.1, pp 61) **Plasma edge turbulence.** Sa, W.P. de; Cruz Junior, D.F. da; Galvao, R.M.O.; Silva, R.P. da. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2509 (ACIESP—60-Vol.1, pp 68) **RFP plasma experiment at INPE.** Ueda, M.; Aso, Y. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2510 (ACIESP—60-Vol.1, pp 69) **Recent results in T.C. - I UNICAMP.** Machida, M.; Aramaki, E.A.; Porto, P.; Sakanaka, P.H.; Ueda, M.; Aso, Y. (Sao Paulo Univ. (Brazil). Inst. de Fisica; UNESP, Guaratingueta (Brazil). Faculdade de Engenharia; Universidade Estadual de Campinas (Brazil). Inst. de Fisica; Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2511 (ACIESP—60-Vol.1, pp 70) **Observation of a fast reconnection time in the FRC formation.** Kayama, M.E.; Sakanaka, P.H.; Machida, M.; Aso, Y.; Busnardo Neto, J.; Boeckelmann, H.K. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2512 (ACIESP—60-Vol.1, pp 59) **Sawteeth fluctuations detection.** Vannucci, A.; Nascimento, I.C. do; Caldas, I.L.; Sanada, E.K.; Tuszel, A.G.; Fagundes, A.N. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2513 (ACIESP—60-Vol.1, pp 71) **Rotational instabilities in field reversed configurations.** Santiago, M.A.M.; Tsui, K.H.; Ponciano, B.M.B.; Sakanaka, P.H. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica; Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2514 (ACIESP—60-Vol.1, pp 72) **Non-stationary classical diffusion in field-reversed configurations.** Clemente, R.A.; Mania, A.J. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2515 **(CONF-870947—11) A fluid-particle simulation model for plasma instabilities.** Lyster, P.M.; Leboeuf, J.N. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01. Order Number DE89001929/JAW.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

Fluid-particle simulation models, often referred to as "hybrid codes," have been used for a number of years to study low-frequency plasma phenomena. In a typical model, the ions are represented by macroparticles, while the electrons are described by fluid equations. This approach uses the low noise associated with a fluid simulation while retaining the kinetic contributions of the ions. When quasineutrality is imposed and the transverse displacement current is neglected, the simulation timestep and the spatial scales are not limited by the usual inverse plasma frequency and the Debye length, respectively. We are developing a new hybrid model for simulating plasma instabilities of characteristic frequency less than the ion cyclotron frequency. The main motivation is to study fluid-like modes such as ion-temperature-gradient driven turbulence; this may be an important mode in high-temperature fusion devices. 4 refs.

2516 **(CONF-871007—119) Transport simulations of ohmic ignition experiment: IGNITEX.** Uckan, N.A.; Howe, H.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE89001941/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The IGNITEX device, proposed by Rosenbluth et al., is a compact, super-high-field, high-current, copper-coil tokamak envisioned to reach ignition with ohmic (OH) heating alone. Several simulations of IGNITEX were made with a 0-D global model and with the 1-D PROCTR transport code. It is shown that OH ignition is a sensitive function of the assumptions about density profile, wall reflectivity of synchrotron radiation, impurity radiation, plasma edge conditions, and additional anomalous losses. In IGNITEX, OH ignition is accessible with nearly all scalings based on favorable OH confinement (such as neo-Alcator). Also, OH ignition appears to be accessible for most (not all) L-mode scalings (such as Kaye-Goldston), provided that the density profile is not too broad (parabolic or more peaked profiles are needed), Z/sub eff/ is not too large (≦2), and anomalous radiation and alpha losses and/or other enhanced transport losses ({eta}/sub i/ modes, edge convective energy losses, etc.) are not present. In IGNITEX, because the figure-of-merit parameters (aB_0^2/q^* {approximately} IB_0, etc.) are large, ignition can be accessed (either with OH heating alone or with the aid of a small amount of auxiliary power) at relatively low beta, far from stability limits. Once the plasma is ignited, thermal runaway is prevented naturally by a combination of increased synchrotron radiation, burnout of the fuel in the plasma core and replacement by thermal alphas, and the reduction in the thermal plasma confinement assumed in L-mode-like scalings. 12 refs., 5 figs., 1 tab.

2517 **(CTH-IEFT-PP—1987-18) On the theory of wave-particle interaction in axisymmetric toroidal systems.** Belikov, V.S.; Lisak, M. (Nuclear Research Institute of Ukrainian SSR Academy of Sciences, Kiev (SU); Chalmers Univ. of Technology, Goeteborg (SE)). (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755118/JAW.

A general formalism is developed to describe the wave-particle interaction in terms of finite-difference mapping equations that incorporate tokamak topology. The concept of overlapping resonances is used to estimate a threshold for a single wave to cause a stochastic particle motion. (authors).

2518 **(DOE/ER/53252—9) 1-D transport modelling of ZT-40M: Report on activity at LANL in Summer 1988.** Veerasingam, R. (Pennsylvania State Univ., University Park (USA)). 29 Sep 1988. Contract FG02-87ER53252. 20p. NTIS, PC A03/MF A01. Order Number DE89001832/JAW.

The object of this work was to obtain transport coefficients that could match experimental behavior of I/sub z/, T/sub e/, n/sub e/ and n/sub i/, while ensuring that F and Θ are in general agreement with experiment. It is stressed that the resulting transport coefficients have no predictive value. The code used is a 1-D transport code which contains a dynamo model that conserves helicity. Ion heating is introduced using various models. In this exercise only 1 data set is matched. The results show that anomalous ohmic heating of 25% to 33% Spitzer resistivity is sufficient to hold T/sub i/ ≧ T/sub e/. For all cases it was found that Θ was approximately 1.46 while F was about -0.07. Both time dependent and radial profiles are studied. Reversal is enforced through a boundary condition on Bz at the wall. The field diffusion times are slow compared to transport times. The magnitude of F and Θ decrease marginally implying that the dynamo model is creating toroidal flux. 11 figs.

2519 **(DOE/ER/53252—10) Use of a zero-dimensional RFP model to simulate behavior of CPRF and ZT-40M: Annual progress report.** Klevans, E.H. (Pennsylvania State Univ., University Park (USA)). 30 Oct 1988. Contract FG02-87ER53252. 21p. NTIS, PC A03/MF A01. Order Number DE89001977/JAW.

An improved zero-dimensional code has been developed and used for comparison with ZT-40M and for parametric studies of the behavior of ZT-H. The code includes equations for energy balance for electrons and ions. Particle density and current are specified quantities. Impurities are treated using a coronal non-equilibrium model. Particle leakage and recycling are included for plasma and impurities. A single particle lifetime is used. The energy confinement times for electrons and ions are specified as multiplicative coefficients times the Ohmic energy confinement time. Energy loss by electrons is assumed to dominate. Ohmic heating is enhanced by an anomaly factor, and an ion heating term is included by use of a multiplicative factor times Ohmic heating. A single set of coefficients is found to simulate a variety of ZT-40M runs with different currents and wall conditions. Both flat top and ramp current waveforms are studied. The resulting model is applied to predict ZT-H behavior for both 2 MA and 4 MA operation. Parametric analysis was performed to evaluate the effect to varying I/N from 3 x 10^{-14} to 6 x 10^{-14}; of varying the recycle time from 5 ms to 1000 ms; and of using two different energy confinement laws, one involving $\beta/$ sub $\theta/$ as a calculated parameter, and one for $\beta/$sub $\theta/ = 0.10$. Low temperatures were obtained for short recycle times and low I/N values. Significantly improved performance was found for the $\beta/$ sub $\theta/ = 0.10$ case. 4 figs., 9 tabs.

2520 **(DOE/ET/51013—247) Spectral analysis of ICRF [Ion Cyclotron Range of Frequencies] wave field measurements in the Tara Central Cell.** Wang, L.; Golovato, S.N.; Horne, S.F. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Dec 1987. Contract AC02-78ET51013. 19p. (PFC/RR—88-3). NTIS, PC A03/MF A01. Order Number DE89001797/JAW.

A simple spectral analysis technique has been developed to analyse the digital signals from an array of magnetic probes for ICRF field measurements in the Tara Tandem Mirror central cell. The wave dispersion relations of both the applied ICRF and the Alfven Ion Cyclotron Instability have been studied and the waves have been identified as slow in cyclotron waves. The radial profiles of field amplitude and wave vectors were also generated. 9 refs., 10 figs.

2521 **(DOE/ET/53088—320) A new concept for muon catalyzed fusion reactor.** Tajima, T.; Eliezer, S.; Kulsrud, R.M. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jun 1988. Contract FG05-80ET53088. 13p. (IFSR—320). NTIS, PC A03/MF A01. Order Number DE89001774/JAW.

A new concept for a muon catalyzed pure fusion reactor is considered. To our best knowledge this constitutes a first plausible configuration to make energy gain without resorting to fissile matter breeding by fusion neutrons, although a number of crucial physical and engineering questions as well as details have yet to be resolved. A bundle of DT ice ribbons (with a filling factor f) is immersed in the magnetic field. The overall magnetic field in the mirror configuration confines pions created by the injected high energy deuterium (or tritium) beam. The DT material is long enough to be inertially confined along the axis of mirror. The muon catalyzed mesomolecule formation and nuclear fusion take place in the DT target, leaving α^{++} and occasionally $(\alpha\mu)^{+}$ (muon sticking). The stuck muons are stripped fast enough in the target, while they are accelerated by ion cyclotron resonance heating when they circulate in the vacuum (or dilute plasma). The ribbon is (eventually) surrounded and pressure-confined by this coronal plasma, whereas the corona is magnetically confined. The overall bundle of ribbons (a pellet) is inertially confined. This configuration may also be of use for stripping stuck muons via the plasma mechanism of Menshikov and Ponomarev. 15 refs., 2 figs.

2522 **(DOE/ET/53088—342) Enhancement of the ion neoclassical heat conduction due to electron and superthermal ion energy-scattering collisions.** Ware, A.A. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Oct 1988. Contract FG05-80ET53088. 6p. (IFSR—342). NTIS, PC A02/MF A01. Order Number DE89002030/JAW.

This paper considers the extra components of neoclassical ion heat conduction driven by energy scattering collisions with electrons and superthermal ions. These components are important in auxiliary heated discharges and can be the most important if the plasma ion distribution has an enhanced non-Maxwellian tail. 5 refs.

2523 **(DOE/ET/53088—348) Computer simulation of Alfven wave heating.** Geary, J.L.; Leboeuf, J.N.; Tajima, T. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Oct 1988. Contract FG05-80ET53088. 48p. (IFSR—348). NTIS, PC A03/MF A01. Order Number DE89002031/JAW.

A particle simulation study of shear Alfven wave resonance heating is presented. A particle simulation model has been developed for this application that incorporates Darwin's formulation of the electromagnetic fields with a guiding center approximation for electron motion perpendicular to the ambient magnetic field. With this model, we examine several cases of Alfven wave heating in both uniform and nonuniform simulation systems in a two-dimensional slab. When the antenna parameters match the shear Alfven resonance condition, the simulation plasmas in the homogeneous cases react strongly with the driven wave. For the inhomogeneous case studies, the kinetic Alfven wave develops in the vicinity of the shear Alfven resonance region. The electrons kinetically react with the wave through a collisionless process. The electron velocity distribution function flattens about the parallel phase velocity of the wave with accompanying changes in the spatial structure of the wave. The electron heating rate is in good agreement with the Landau damping model. A substantial electron current is also generated parallel to the applied magnetic field. The ions gain energy by oscillating in the wave electric fields. 25 refs., 17 figs.

2524 **(DOE/ET/53088—351) Theory of neoclassical pressure-gradient-driven turbulence.** Kwon, O.J.; Diamond, P.H.; Biglari, H. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Nov 1988. Contract FG05-80ET53088;FG03-88ER53275. 30p. (IFSR—351). NTIS, PC A03/MF A01. Order Number DE89002464/JAW.

The nonlinear evolution and saturation of neoclassical pressure- gradient-driven turbulence (NPGDT), evolving from linearly unstable bootstrap current modes, are investigated. The theoretical model is based on " neoclassical MHD equations" which are valid in the banana-plateau regimes of collisionality. Modes with poloidal wavelengths shorter than radial wavelengths are shown to be suppressed. From nonlinear saturation conditions, the turbulent pressure diffusivity is determined as an eigenvalue of the renormalized equations. Levels and radial scales of turbulence are determined from the pressure diffusivity and are shown to exceed mixing length estimates by powers of a nonlinear enhancement factor. The problem of the electron heat transport due to stochastic magnetic fields driven by NPGDT is revisited. The reconsideration of the radial structure of magnetic flutter leads to estimates of the electron heat transport and magnetic fluctuation levels which differ qualitatively and quantitatively from previous calculations. 25 refs.

2525 **(GA-A—19107) Electron density measurements from cutoff of electron cyclotron emission in the DIII-D tokamak.** Lohr, J. (General Atomics Co., San Diego, CA (USA)). Jul 1988. Contract AC03-84ER51044. 17p. (CONF-880364—35). NTIS, PC A03/MF A01. Order Number DE89001435/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Cutoff of microwave emission at the second harmonic of the electron cyclotron frequency has been used to infer the local electron density profile in the DIII-D tokamak. Modeling the density profile during the uncontrolled density increase associated with the transition to H-mode operation permits the profile shape factor and line average to be estimated. Independent corroboration of the

standard density diagnostics, Thompson scattering, and laser interferometry has been performed with this technique. 7 refs., 6 figs.

2526 **(GA-A—19443) Energy confinement in auxiliary-heated divertor and limiter discharges in the DIII-D Tokamak.** Burrell, K.H.; Allen, S.L.; Bramson, G.; Brooks, N.H.; Callis, R.W.; Carlstrom, T.N.; Chance, M.S.; Chu, M.S.; Colleraine, A.P.; Content, D. (General Atomics Co., San Diego, CA (USA); Lawrence Livermore National Lab., CA (USA); Johns Hopkins Univ., Baltimore, MD (USA); Shinetsu Chemical Industry Co. Ltd., Takefu, Fuki (Japan); Hitachi Ltd., Tokyo (Japan); JET Joint Undertaking, Abingdon (UK); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); California Univ., Irvine (USA); Japan Atomic Energy Research Inst., Tokyo; Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland); Nagoya Univ. (Japan). Inst. of Plasma Physics; University of Southern California, Los Angeles (USA)). Oct 1988. Contract AC03-84ER51044. 14p. (CONF-881015—22). NTIS, PC A03/MF A01. Order Number DE89001438/JAW.

From 12. international conference on plasma physics and controlled nuclear fusion research; Nice, France (12 Oct 1988).

We have determined the scaling of the H-mode power threshold with various plasma parameters; the roughly linear increase with plasma density and toroidal field are particularly significant. The data indicate that the H-mode transition is associated with the sudden reduction in anomalous, fluctuation-connected transport across the outer midplane of the plasma. We find that the edge localized modes (ELMs) are triggered when the pressure gradient at the edge of the plasma exceeds the threshold given by ideal ballooning theory. Energy confinement time increases linearly with plasma current until the safety factor at the 95% flux surface q^{95} drops below three; at $q_{95} < 3$, it is independent of current and, at constant q_{95}, depends linearly on toroidal field. Controlling the effects of ELMs has allowed us to produce nearly-steady-state plasmas with H-mode durations up to 4.4 seconds. Energy confinement time in H-mode plasmas created with Ohmic heating alone shows a factor of two improvements over standard Ohmic plasmas. Confinement time in 2.0 MA H-mode plasmas with neutral beam heating can significantly exceed the standard Ohmic value also. Local transport studies have shown that the thermal diffusivity in the outer half of the plasma in neutral-beam-heated H-mode is a factor of three lower than the L-mode diffusivity at the same plasma density. 32 refs., 8 figs.

2527 **(INIS-BR—1288) Dynamic of compression and mechanisms of plasma heating in Θ-Pinch.** Shigueoka, Y. (Universidade Estadual de Campinas (Brazil). Inst. de Fisica). 1979. 73p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88704531/JAW.

It has been developed a (1 + zero) D model, sharp boundary in r and 1D in z, to study dynamics of Θ- pinches with bias field, in order to calculate bounce oscillations, plasma temperature, effects of plasma temperature, effects of plasma radius on the discharge and the influence of finiteness of the Θ- pinch coil length on the bounce oscillations. It was observed that the effect of plasma radius variation on discharge is appreciable. It can even invert the sign of dB/sub z//dt. The influence of the finite length coil is manifested through oscillations of quantities, such as, b/sub z/, R, T/sub i/ and B/sub i/ along z axis. These oscillations are simply bounce oscillations transformed oscillations in z direction, and do not mean a new instability.

2528 (INIS-mf—11319, pp 50) **Plasma evolution in laser-irradiated cylindrical cavities.** Cunningham, P.F.; Weber, R.; Ladrach, P.; Balmer, J.E. (Natal Univ., Durban (South Africa). Plasma Physics Research Inst.; Bern Univ. (Switzerland). Inst. fuer Physik). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2529 (INIS-mf—11319, pp 51) **Transport in a stochastic Tokamak edge layer.** Hellberg, M.A.; Feneberg, W. (Natal Univ., Durban (South Africa). Plasma Physics Research Inst.; M.P.I. fur Plasmaphysik (Federal Republic of Germany)). 1988. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88704355/JAW. (CONF-8807126—).

From 33. annual conference of the South African Institute of Physics; Grahamstown, South Africa (4 Jul 1988).

2530 **(INPE—4387) Efficiency calculation of electron cyclotron-resonance masers (gyrotrons).** Castro, J.J.B. de; Montes, A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Sep 1987. 11p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704566/JAW.

The relativistic equation which describes the electron movement, of an annular section beam, in the electromagnetic field of a cylindrical waveguide that operates in TE sub (021) mode is numerically solved. The energy exchange processes between the beam and RF fields are investigated, calculating the electron energy into the cavity. The energy extracted by electromagnetic fields of resonance cavities is provided from crossed energy of electron rotation. (M.C.K.).

2531 **(INPE—4391) Absorption of electron cyclotron radiation in tokamak plasmas with a superthermal tail in the electron velocity distribution.** Montes, A.; Dendy, R.O. (Euratom-UKAEA Association, Abingdon). (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Sep 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704567/JAW.

A monotonically decreasing superthermal tail in the distribution of electron velocities parallel to the tokamak magnetic field is represented by adding a drifted Maxwellian distribution to a bulk Maxwellian distribution. This combines a high degree of flexibility in the set of tail parameters available with the possibility of obtaining exact analytic expressions for the dielectric tensor elements. Calculations have been carried out in the nonrelativistic limit, which restricts its applicability to the extraordinary mode away from normal incidence. A fully three-dimensional ray tracing code which includes the effects of toroidal geometry is employed. The results indicate that small tails (tail fraction $\sim$ 0.5%) can significantly alter the wave absorption characteristics. These include the integrated absorption, spatial deposition profile, and velocity space deposition profile. Due to the presence of tail electrons, significant heating above the high density cutoff is found for high field side louching with W = ω/sub c/ (central), together with strong absorption at low density for low field side louching with W << ω/sub c/ (central).

2532 **(IPP—III/134) DPG-Fruehjahrstagung. ASDEX contributions to the DPG Fruehjahrstagung.** (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Apr 1988. 58p. (CONF-8802115—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755290/JAW.

From Spring meeting of the Technical Committees of Extraterrestrial Physics, High-Speed Physics and plasma Physics of Deutsche Physikalische Gesellschaft e.V. (DPG); Duesseldorf, F.R. Germany (29 Feb 1988).

This report is a collection of 9 IPP Garching contributions concerning: 1. Charge exchange spectroscopy (CXRS) of highly ionized ions in ASDEX, 2. Spectroscopic measurement of the ion temperature of ASDEX, 3. Measurement of the absolute neutron yield of ASDEX with nuclear emulsion plates, 4. Interpretation of neutron rate measurements using the NR code, 5. Calculation of neutron propagation for ASDEX, 6. Numerical simulation of the response function of a nuclear emulsion plate, 7. Measurements of proton and triton spectra in ASDEX discharges, 8. Advantages of a helium beam for active charge exchange diagnostics, and 9. Simultaneous background measurement in the ASDEX neutral particle diagnostics.

2533 **(IPPJ—806) Time resolved heliumlike titanium spectra from JIPP T-IIU tokamak.** Kato, Takako; Morita, Shigeru; Masai, Kuniaki; Hayakawa, Satio. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780126/JAW.

Time resolved measurements of TiXXI-TiXIX X-ray line spectra from an ohmically heated plasma with neon puffing in the JIPP T-IIU tokamak were measured with a high resolution crystal spectrometer. The spectral data were analyzed by the use of a collisional radiative model which includes the cascade contributions from highly excited states as well as the recombination processes. We have fitted the observed spectra with synthetic calculations taking all the possible lines into account. From the intensity ratios of the satellite lines to the resonance line, the electron temperatures T/sub e/ was obtained every 20 ms. The result indicates that the plasma is in an ionizing phase at the beginning, reaches nearly an equilibrium around 80 ms and then turned into a recombination phase thereafter following the decrease of the electron temperature. The observed intensity ratios T/sub x//I/sub y//I/sub w/ were always found more than twice larger than the theoretical ones. The discrepancies increased in the later period of the plasma after T/sub e/ decreased, in contrast to the result by Bitter et al. who found large discrepancies in the early phase of the discharge when T/sub e/ was low. However the experimental data of I_2/I/sub w/ are in good agreement with calculations when we include the inner-shell ionization of Li-like ions. We investigated the contribution of ion-ion charge exchange processes to the ion abundances and the line intensities.

2534 **(IPPJ—807) Hybrid code simulation on mode conversion in the second harmonic ICRF heating.** Sakai, Kazuo; Takeuchi, Satoshi; Matsumoto, Michio; Sugihara, Ryo. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1986. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780127/JAW.

ICRF second harmonic heating of a single-species plasma is studied by using a 1 - 1/2 dimensional quasi-natural hybrid code. Mode conversion, transmission and reflection of the magnetosonic waves are confirmed, both for the high- and low-field-side excitations. The ion heating by waves propagating perpendicularly to the static magnetic field is also observed.

2535 **(IPPJ—808) Acceleration of energetic ions by a nearly perpendicular interplanetary shock.** Ohsawa, Yukiharu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1986. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780128/JAW.

The theory of resonant ion acceleration which has been recently developed is compared quantitatively with the acceleration of energetic ions by a quasiperpendicular shock observed by Voyager 2 at a distance of 1.9 AU from the Sun. The theory explains many important features of the experimental results.

2536 **(IPPJ—809) Nonlinear phenomena due to an m = 1 non-resonant current-driven mode in RFP with relatively high S number.** Nakajima, Noriyoshi. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780129/JAW.

Nonlinear phenomena due to non-resonant current-driven modes with poloidal mode number m = 1 are examined using a numerical simulation of an incompressible helical symmetric plasma with relatively high S number. It is found that the nonlinear interaction between the m = 0 and m = 1 modes brings a nonlinear oscillation immediately after the linear growth stage and subsequently a nonlinear reconnection takes place. This nonlinear oscillation occurs around a helical equilibrium in close vicinity to the initial axisymmetric equilibrium. It should be noted that the slow nonlinear reconnection occurs after the nonlinear oscillation is completely or almost completely damped out by the dissipation. The occurrence of this nonlinear reconnection is owing to the reversal of the current induced by a largely deformed helical flux function.

2537 **(IPPJ—821) Macroscopic stability of rotating and propagating LIB.** Aoki, Takayuki; Niu, Keishiro. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780135/JAW.

The linear stabilities of a rotating and propagating light ion beam in a low density plasma are studied numerically on the oasis of the hydromagnetic equations. The centrifugal force acts on the beam and the self-magnetic fields is induced by the rotating and propagating charged particles. To clarify the physical mechanism, a phenomenon appearing in a simple model is analyzed, and it is found that the centrifugal force and the magnetic field in the azimuthal direction play a role of stabilization. For such beam parameters practically required as the energy driver for inertial confinement fusion, the numerical results indicate that the beam in the equilibrium state tends to be stable if the ratio of the beam rotating velocity to the propagating one is more than the value of 0.8.

2538 **(IPPJ—829) Magnetohydrodynamic equilibrium and stability of spheromak by boundary-fitted curvilinear coordinate system. Improvement of plasma confinement by external coil.** Kamitani, Atsushi; Kaneko, Shobu; Uyama, Tadao; Watanabe, Kenji. (Tokyo Univ., Japan. Faculty of Engineering). (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780113/JAW.

The flux conserver actually used in spheromak experiments has an entrance hole and a duct to introduce a plasma into it. The effect of the hole keeps some magnetic surfaces from closing in the flux conserver. A method of closing all surfaces is to place an external coil near the entrance hole and apply an electric current I/sub c/ whose direction is opposite to the plasma current I/sub p/. Equilibrium configurations of the spheromak plasma in the flux conserver with the external coil are determined by using the boundary- fitted curvilinear coordinated system. The stability of these configurations are investigated by suing the Mercier criterion. The results of computations show the plasma confinement is poor if T/sub c//I/sub p/ 4a 0, but it is considerably improved if I/sub c/ I{sub p} > approx. 1/2 is satisfied.

2539 **(IPPJ—830) V/sub p/ x B acceleration. A new mechanism of particle acceleration by waves.** Sugihara, Ryo. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780114/JAW.

A unique particle acceleration by an electrostatic (ES) wave, a magnetosonic shock wave as well as an electromagnetic (EM) wave is reviewed. The principle of the acceleration is that when a charged particle is carried across an external magnetic field the charge feels a DC field (the Lorentz force) and is accelerated. The theory for the ES wave acceleration is experimentally verified though it is semi-quantitative. The shock acceleration is extensively studied theoretically and in a particle simulation method and the application is extended to phenomena in interplanetary space. The EM wave acceleration is based on a trapping in a moving neutral sheet created by the wave magnetic field and the external magnetic field, and the particle can be accelerated indefinitely. A brief sketch on a slow- wave-structure for this acceleration will be given.

2540 **(IPPJ—831) Neoclassical resonant-plateau transport calculation in an effectively axisymmetrized tandem mirror with finite and plate resistance.** Katanuma, I.; Kiwamoto, Y.; Adachi, S.; Inutake, M.; Ishii, K.; Yatsu, K.; Sawada, K.; Miyoshi, S. (Tsukuba Univ., Sakura, Ibaraki, Japan. Plasma Research Center). (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1987. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780115/JAW.

Calculations are made for neoclassical resonant-plateau transports in the geometry of the effectively axisymmetrized tandem mirror Γ 10 magnetic field, which has minimum B inboard anchors inside the axisymmetric plug/barrier mirror cells. Azimuthal drifts at the local non-axisymmetric regions are included. The radial potential profile is determined by solving self consistently the charge neutrality equation. A finite resistance connecting and plate to ma-

chine ground provides appropriate boundary conditions on the radial electrostatic potential distribution so that it can be determined uniquely. The calculation is consistent with experimental results of Γ 10.

2541 **(IPPJ—832) Relativistic shock wave.** Ohsawa, Yukiharu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780116/JAW.

Perpendicular shock waves in rather strong magnetic fields (3[/sub ce/ > approx. 3[/sub pe/) are studied by a 1 - 2/2 dimension, fully relativistic, fully electromagnetic particle simulation with full ion and electron dynamics. In that parameter regime relativistic effects become important in fast magnetosonic shock waves, even if the thermal speeds of ions and electrons in the upstream region are much smaller than the speed of light; a shock wave can trap some ions and promptly accelerate them to relativistic energies. Furthermore, with the mechanism different from that of ions, some electrons also gain relativistic energies through interactions with strong electric fields in the shock region. By showing various simulation results, we discuss the acceleration processes in detail.

2542 **(IPPJ—833) Ambipolar electric field and energy confinement time in the compact helical system (CHS) device.** Sanuki, H.; Kamimura, T.; Fujiwara, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780117/JAW.

On the basis of simple neoclassical transport theory, qualitative features of ambipolar electric field and energy confinement time are studied for the parameters of the Compact Helical System (CHS) device under construction. The dependence of the transition between the electron root (E > 0) and the ion root (E < 0) on plasma parameters such as the density and temperature are studied in detail. Effects of the anamolous losses via electron channel on the energy confinement time are also discussed briefly.

2543 **(IPPJ—834) Experimental evidences of electrothermal ablation acceleration of water.** Ikuta, Kazunari. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1987. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780118/JAW.

We report the first demonstrations of driving water of about 1000 grams by electro-thermally ablated gas pressure in a cavity with a single exhauster. A blob of water was shot into the air with a shooting angle of about 45{degree}, and the flight velocity observed was about 13 meters per second with the capacitor (28 3=F) charged up to 10 KV. The discharge sound was almost suppressed by the water blob loaded in the chamber possibly because the energy of sound was dissipated into the water blob. The application of this ablation water driver to ship propulsion is also discussed.

2544 **(IPPJ—836) Resonance absorption of ICRF wave in edge plasma.** Sugihara, Ryo; Yamanaka, Kaoru. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780119/JAW.

An edge plasma is shown to significantly absorb ICRF wave when a resonant triplet, a cutoff-resonance-cutoff triplet, is constructed in the evanescent region. Two-ion-component plasmas in a torus are considered though the plasmas are modeled by a slab in which the density changes linearly along the x-axis. The resonance is a perpendicular-ion-cyclotron resonance, i.e., an Alfîven resonance, and is formed when the applied frequency 3[is smaller than the local cyclotron frequency, at the edge of the antenna side, of the lighter species of ions. Roughly the absorption rate A/sub b/ is given by M² >> S/sup 2 and S{sup 4} for S{sup 2} >> M{sup 2} where M = k{sub y}1 and S 4A k{sub z}1 and 1 is a scale length of the order of the plasma minor radium and k{sub y} and k{sub z} are the perpendicular and the parallel components of the wave vector. It is noted that the both quantities, M and S, readily become of the order of unity. Since A{sub b} is not very sensitive to the density ratio of the two ion species, a few percent of impurities may cause a significant absorption. As the mass ratio of the two ion species comes close to unity the triplet forms readily. Therefore a D-T plasma seems to suffer more easily this kind of resonance absorption than a D-H plasma.

2545 (IPPJ—859, pp 81-101) **Numerical simulation for particle acceleration and trapping by an electromagnetic wave.** Kawata, Shigeo; Matsumoto, Masami; Masubuchi, Yukio. (Technological Univ. of Nagaoka, Niigata (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

The interaction between particles and an electromagnetic (EM) wave is investigated numerically in the system of particle V/ sub p/xB acceleration by the EM wave. Numerical simulations show that the particle acceleration mechanism works well in the case of the appropriate number density of the imposed particles. When the interaction between particles and the wave is too strong, a part of the trapped and accelerated particles is detrapped. A condition is also presented for the efficient particle acceleration and trapping by the EM wave.

2546 **(ITEF—193(1987)) Numerical calculations of heterogeneous equilibrium states of emitting z-pinches.** Bobrova, N.A.; Razinkova, T.L.; Sasorov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A03/ MF A01. Order Number DE88704579/JAW.

Numerical calculation results of equilibrium states of emitting Z-pinches with account of electron heat conductivity are presented. Results are compared with experimental data on Cu and W wires explosion. Satisfied quantitative correspondence of a model and experiment indicates model relative adequacy and, as well, that radiation blackout within lines is not very essential for plasma parameters within radiating range and more external layers. On these calculations base failure criterion of wire current-carrying part while its operation in multiwire liners is determined. 5 refs.; 8 figs.; 3 tabs.

2547 **(JAERI-M—88-120) Multi-channel bolometer system on JFT-2M tokamak.** Tamai, Hiroshi; Maeno, Masaki; Matsuda, Toshiaki; Matoba, Tohru. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755221/JAW.

Multi-channel bolometer system is designed and installed to observe the radiation profile on JFT-2M tokamak. Sensor head is made of Thinistor, which is a kind of semiconductor, because it has the advantage of higher sensitivity of about one order of magnitude than the conventional metal foil bolometer and is suitable for the profile measurement in which the signal from the plasma is relatively small. The response and cooling characteristics of the bolometer sensor are suitable for the condition of JFT-2M tokamak plasma. Low noise circuit of bridge and differentiator is developed to optimize the signal to noise ratio in the JFT-2M operating condition. With use of the bolometer system, the radiation profile in joule heating plasma as well as additional heating plasma especially in H-mode plasma is successfully observed.

2548 **(JAERI-M—88-126) Spectrograms of the JT-60 plasmas in the vacuum ultraviolet region (wavelength region 15 {similar←to} 1360 A).** Kubo, Hirotaka; Sugie, Tatsuo; Sakasai, Akira; Koide, Yoshihiko; Nishino, Nobuhiro; Akaoka, Nobuo. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 36p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755226/JAW.

Spectrograms in the vacuum ultraviolet region have been obtained by a 3 m grazing incidence spectrograph in order to study impurity behaviors in JT-60 plasma. The spectrograms have been investigated in the first OH experiments, High-Ti mode experiments, and the experiments that were carried out after the replacement of 40 % of the first wall of the vacuum vessel with graphite

tiles. In the first OH experiments, the spectrogram which covered the wavelength region of 15 {similar←to} 1360 A was obtained, and spectral lines of oxygen, carbon, and titanium were identified. In High-Ti mode experiments, the spectrogram which covered the wavelength region of 17 {similar←to} 77 A was obtained, and spectral lines of highly ionized molybdenum were identified in addition to those of oxygen, carbon, and titanium. In the experiments after the replacement of the first wall, the spectrogram which covered the wavelength region of 15 {similar←to} 55 A was obtained, and it was found clearly that the metallic impurities decreased.

2549 **(LA-UR—88-2962) Experimental signatures of localization in Langmuir wave turbulence.** Rose, H.A.; DuBois, D.F.; Russell, D.; Bezzerides, B. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 43p. (CONF-8803153—1). NTIS, PC A03/MF A01. Order Number DE89000372/JAW.

From Conference on physics of wave collapses; Novosibirsk, USSR (1 Mar 1988).

Features in certain laser-plasma and ionospheric experiments are identified with the basic properties of Langmuir wave turbulence. Also, a model of caviton nucleation is presented which leads to certain novel scaling predictions. 12 refs., 19 figs.

2550 **(LA-UR—88-3145) Three-dimensional plasma measurements from three-axis stabilized spacecraft.** Bame, S.J.; Martin, R.H.; McComas, D.J.; Burch, J.L.; Marshall, J.A.; Young, D.T. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 36p. (CONF-8802110—1). NTIS, PC A03/MF A01. Order Number DE89000361/JAW.

From Yosemite conference on outstanding problems in solar system plasma physics: theory and instrumentation; Yosemite, CA, USA (2 Feb 1988).

Future planetary missions require that comprehensive three-dimensional measurements of electrons and mass-resolved ions be made from three-axis stabilized spacecraft. In order to make these measurements without requiring expensive and resource intensive platforms to scan space mechanically, we are developing various systems that are designed to scan space electrostatically. These systems also make it possible to circumvent the significant shadowing that would be present even with a scan platform, caused by necessary spacecraft appendages such as communications antennas and a power source (RTG or solar cell panels). The systems, which are axially symmetric, select particles arriving from 360{degree} in azimuth along conical surfaces whose polar (or elevation) angles, referenced to the instrument symmetry axes, are determined by applying suitable deflection voltages to shapes deflectors. Particles thus selected in polar angle pass into spherically or toroidally-shaped electrostatic analyzers. After analysis, the 360{degree} outputs of the analyzers are divided into discrete angular swaths to provide azimuthal angle resolution. In the case of electrons, the analyzed particles can be detected directly; in the case of ions, the particles in each swath can be counted directly, or further analyzed with time-of-flight or magnetic analyzers to obtain the velocity distributions of the separated major ion constituents. We present computer simulations of particle paths through the various analyzers of this type and show results from laboratory calibrations of prototypes.

2551 **(LA-UR—88-3323) Confinement dynamics and boundary condition studies in the Reversed Field Pinch.** Schoenberg, K.F.; Ingraham, J.C.; Moses, R.W. Jr.; Weber, P.G.; Burkhardt, L.C.; Cayton, T.E.; DiMarco, J.N.; Downing, J.N.; Ellis, R.F.; Gerwin, R. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (IAEA-CN—50/C-2-1; CONF-881015—26). NTIS, PC A03/MF A01. Order Number DE89002045/JAW.

From 12. international conference on plasma physics and controlled nuclear fusion research; Nice, France (12 Oct 1988).

The study of confinement dynamics, including investigation of the boundary conditions required for plasma sustainment, are central to the development of the Reversed Field Pinch (RFP) concept. Recently, several insights into confinement have emerged from a detailed investigation RFP electron and ion dynamics. These insights derive from the recognition that both magnetohydrodynamic (MHD) and electron kinetic effects play an important and coupled role in RFP stability, sustainment, and confinement. In this paper, we summarize the results of confinement studies on the ZT-40M experiment, and boundary condition studies on the Wisconsin non-circular RFP experiment. A brief description of the newly commissioned Madison Symmetric Torus (MST) is also presented. 28 refs., 3 figs.

2552 **(LA-UR—3318) "Flicker" in laser-plasma self-focusing.** Coggeshall, S.V.; Mead, W.C.; Jones, R.D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-881056—4). NTIS, PC A02/MF A01. Order Number DE89002049/JAW.

From 19. European conference on laser interaction with matter (ECLIM); Madrid, Spain (3 Oct 1988).

Under certain conditions, a new mode of laser-plasma self-focusing can occur which is characterized by a self-sustaining, continual shifting of filament-produced focal spots and a somewhat chaotic redistribution of light at the critical surface. Associated with this phenomenon is the possibility of significant intensity multiplication due to self-focusing. This flickering of laser light is caused by small amplitude, short wavelength ion acoustic waves which are produced near the foci of the filaments and subsequently propagate and convect toward the laser. As these ion fluctuations move toward the laser, they cause further light ray trajectory changes which shift the locations of the foci. New sound waves are launched and the process is self-perpetuated. 7 refs., 5 figs.

2553 **(N—88-25323) MHD bending waves in a current sheet.** Musielak, Z.E.; Suess, S.T. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). 1986. 36p. (NASA-TM—101149; NAS—1.15:101149). NTIS, PC A03/MF A01.

Transverse MHD bending waves are considered in an isothermal and compressible two-dimensional current sheet of finite thickness in which the magnetic field changes direction and strength. The general form of the wave equation is obtained. It is shown that rotation of the magnetic field across the current sheet prevents the existence of singular points so that continuous spectrum solutions and the concomitant wave decay disappear. Instead, normal modes exist and closed integral solution for arbitrary current sheet structure are found. The results are discussed in terms of small-scale waves on the heliospheric current sheet.

2554 **(ORNL/FEDC—88/5) The impact of confinement scaling on ITER [International Thermonuclear Experimental Reactor] parameters.** Reid, R.L.; Galambos, J.D.; Peng, Y.K.M. (Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center). Sep 1988. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01. Order Number DE89001951/JAW.

Energy confinement scaling is a major concern in the design of the International Thermonuclear Experimental Reactor (ITER). The existing database for tokamaks can be fitted with a number of different confinement scaling expressions that have similar degrees of approximation. These scaling laws predict confinement times for ITER that vary by over an order of magnitude. The uncertainties in the form and magnitude of these scaling laws must be substantially reduced before the plasma performance of ITER can be predicted with adequate reliability. The TETRA systems code is used to calculate the dependence of major ITER parameters on the scaling laws currently in use. Design constraints of interest in the present phase of ITER consideration are used, and the minimum-cost devices arising from these constraints are reviewed. 9 refs., 13 figs., 4 tabs.

2555 **(ORNL/TM—10947) Nonlinear dynamics of single-helicity neoclassical MHD tearing instabilities.** Spong, D.A.; Shaing, K.C.; Carreras, B.A.; Callen, J.D.; Garcia, L. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 36p. NTIS, PC A03/MF A01. Order Number DE89001960/JAW.

Neoclassical magnetohydrodynamic (MHD) effects can significantly alter the nonlinear evolution of resistive tearing instabilities. This is studied numerically by using a flux-surface-averaged set of evolution equations that includes the lowest-order neoclassical MHD effects. The new terms in the equations are fluctuating

bootstrap current, neoclassical modification of the resistivity, and neoclassical damping of the vorticity. Single-helicity tearing modes are studied in a cylindrical model over a range of neoclassical viscosities (μ/sub e//ν/sup e/) and values of the Δ′ parameter of tearing mode theory. Increasing the neoclassical viscosity leads to increased growth rate and saturated island width as predicted analytically. The larger island width is caused by the fluctuating bootstrap current contribution in Ohm's law. The Δ′ parameter no longer solely determines the island width, and finite-width saturated islands may be obtained even when Δ′ is negative. The importance of the bootstrap current ({approximately}∂{rho}/{partial←derivative{psi}) in the nonlinear dynamics leads us to examine the sensitivity of the results with respect to different models for the density evolution. 11 refs., 8 figs.

2556 **(SAND—88-2676C) BUCKSHOT diagnostics.** Wagner, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-8809149—22). NTIS, PC A02. Order Number DE89001682/JAW.

From DARPA/SDIO services annual propagation review; Newport, RI, USA (12 Sep 1988).

BUCKSHOT is a 3-D particle code written to study the IFR propagation of REB's. Its structure makes a departure in philosophy from many other of Sandia's older particle simulation codes. Previously, many of our simulation codes were designed to run in batch mode, with a 'fire and forget' philosophy. BUCKSHOT, on the other hand, is not a single program. It consists of an interactive main program and a menu of interactive post-processors that read from the main program's data base. This makes it possible to generate endless combinations of output on many different devices, including movies from a single run. Wasted resources that are associated with unwanted output are avoided. 4 figs.

2557 **(UCID—99583) Current drive by intense microwave pulses.** Cohen, R.H.; Cohen, B.I.; Nevins, W.M.; Rognlien, T.D.; Bonoli, P.T.; Porkolab, M. (Lawrence Livermore National Lab., CA (USA)). 14 Sep 1988. Contract W-7405-ENG-48. 15p. (CONF-880735—1). NTIS, PC A03/MF A01. Order Number DE89001287/JAW.

From International workshop on nonlinear phenomena in Vlasov plasmas; Cargese, France (11 Jul 1988).

The advent of high-peak-power pulsed microwave sources opens possibilities for novel current-drive schemes in tokamaks. Four such schemes are considered: accelerating phase-space buckets, overlap of relativistic electron-cyclotron harmonics, beat-wave generation and burnthrough of intense lower-hybrid waves. These schemes are found to offer one or more of the following advantages over their continuous-power counterparts: improved efficiency, improved access to the core plasma, and precise control of the deposition profile. 17 refs.

2558 **(UCRL—99368) IMP [Intense Microwave Prototype], a free-electron laser amplifier for plasma heating in the Microwave Tokamak Experiment.** Jong, R.A.; Atkinson, D.P.; Byers, J.A.; Coffield, F.E.; Deis, G.A.; Felker, B.; Ferguson, S.W.; Fontaine, R.A.; Hopkins, D.B.; Makowski, M. (Lawrence Livermore National Lab., CA (USA)). 1 Aug 1988. Contract W-7405-ENG-48. 25p. (CONF-8808146—1). NTIS, PC A03/MF A01. Order Number DE89001920/JAW.

From 10. international free-electron laser conference; Jerusalem, Israel (29 Aug 1988).

The Intense Microwave Prototype (IMP) is an induction-linac based free-electron laser (IFEL) amplifier system that is presently under construction at the Lawrence Livermore National Laboratory (LLNL). It will produce up to 2 MW of average power at 250 GHz for electron cyclotron resonance heating experiments in the Microwave Tokamak Experiment (MTX). The Experimental Test Accelerator-II (ETA-II) will provide the electron beam. ETA-II is designed to produce an electron beam with a current of 3 kA at an energy of 10 MeV and a brightness of over 10{sup 8} A/(m-rad){sup 2}. In addition, it is designed to produce 70-ns-FWHM pulses at a repetition rate of 5 kHz. The high magnetic field and wide tunability capabilities required for the FEL will be provided by a permanent magnet-laced electromagnetic wiggler with a 10-cm period and an overall length of 5.5 m. We present the physics design and expected performance of the FEL, along with a description of the experiment and of the phased development to high average power. 17 refs., 8 figs.

2559 **Modeling, measurements, and analysis of x-ray emission from 0.26-μm-laser-irradiated gold disks.** Mead, W.C.; Stover, E.K.; Kauffman, R.L.; Kornblum, H.N.; Lasinski, B.F. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 10, 5275-5288(15 Nov 1988).

We present modeling, measurements and analysis that extend our understanding of laser-plasma coupling and x-ray conversion processes to shorter laser wavelengths at kilojoule energies. We have studied the x-ray emission from gold-disk targets irradiated at 0.26-μm wavelength, using 0.5—1.5-kJ, 1-ns full width at half maximum Gaussian pulses at intensities of 1 x 10/sup 14/—2 x 10/sup 15/ W/cm². We interpret measurements of the absolute broadband x-ray spectrum, the time history of sub-keV x-ray emission flux, and the broadband hard-x-ray spectrum. We find negligible hot-electron levels (<10/sup -3/E/sub inc/). We infer increased conversion of incident light to soft x rays (72% +- 15% at 1 x 10/sup 14/ and 38% +- 12% at 2 x 10/sup 15/), compared with longer wavelengths, as predicted. We find good overall agreement between the modeling and the data, but identify some areas that need to be better understood, including certain aspects of the x-ray emission spectrum and the decay rate of the emission pulse.

2560 **Measurement of single 14 MeV neutron bursts with 100 ps time resolution.** Kania, D.R.; Lane, S.M.; Prussin, S.G. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Applied Physics Letters;* **53**: No. 20, 1988-1989(14 Nov 1988).

We have constructed a detector using neutron-damaged GaAs and used it to measure subnanosecond 14 MeV neutron bursts from laser-driven deuterium-tritium filled microspheres. The detector's very fast response (measured to be 60 ps full width at half-maximum) is due to the phenomenon of radiation-induced conductivity. The absolute sensitivity of the detector has been measured and is in excellent agreement with Monte Carlo calculations. We have also verified that the dectector is linear with neutron flux over two orders of magnitude.

2561 **Power spectra of fluctuations in strong Langmuir turbulence.** DuBois, D.F.; Rose, H.A.; Russell, D. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **61**: No. 19, 2209-2212(7 Nov 1988).

The power spectral densities of turbulent fluctuations computed from Zakharov's model are shown to have unexpected structure which results from the coherent temporal evolution of cavitons. These spectra have features in common with the spectra measured during ionispheric heating.

2562 **Streamer formation in plasma with a temperature gradient.** Drake, J.F.; Guzdar, P.N.; Hassam, A.B. (Laboratory for Plasma Research, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **61**: No. 19, 2205-2208(7 Nov 1988).

Turbulence produced by a temperature gradient in a collisional plasma is investigated. The system evolves to a state in which highly elongated streams of plasma move up and down the temperature gradient. The resulting transport greatly exceeds estimates based on mixing length arguments. It is argued that such streams are the preferred nonlinear state of turbulent fluctuations driven by both delT/sub e/ and delT/sub i/.

2563 **Plasma heating by two laser fields.** Fonseca, A.L.A.; Nunes, O.A.C.; Araga-tildeo, F.R.F. (Physics Department, University of Brasilia, 70 910, Brasilia, D.F., Brazil). *Physical Review* [*Section*] *A: General Physics;* **38**: No. 9, 4732-4736(1 Nov 1988).

The heating of a plasma by electrons in the simultaneous presence of weak and strong laser fields by the inverse bremsstrahlung process is considered from a quantum-mechanical viewpoint. A kinetic equation is derived and the change in kinetic energy of

the plasma electrons is calculated. Results show that the joint action of the two laser beams gives a nonvanishing but large heating rate in the regime of high intensity of the strong field. A physical explanation for this behavior is provided.

2564 **Kinetic theory of ion collection by probing objects in flowing strongly magnetized plasmas.** Chung, K.; Hutchinson, I.H. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] A: General Physics;* **38**: No. 9, 4721-4731(1 Nov 1988).

A new one-dimensional collisionless kinetic model is developed for the flow of ions to probing structures in drifting plasmas. The cross-field flow into the presheath is modeled by accounting consistently for particle exchange between the collection flux tube and the outer plasma. Numerical solutions of the self-consistent plasma-sheath equations are obtained with arbitrary external ion temperature and parallel plasma flow velocity. Results are presented of the spatial dependence of the ion distribution function as well as its moments (density, particle flux, temperature, and power flux). The ion current to the probe is obtained and the ratio of the upstream to downstream currents is found to be well represented by the form R = exp(Ku/sub d/), where K~1.7 and u/sub d/ is the drift velocity in units of √(T/sub e//m/sub i/) . The results are in good agreement with comparable recent fluid calculations but show substantial deviations from other models which ignore particle exchange out of the presheath. No evidence is found of the formation of shocks in the downstream wake, contrary to the implications of some fluid theories.

2565 **Scanning polarimeter for measurement of the poloidal magnetic field in a tokamak.** Wroblewski, D.; Huang, L.K.; Moos, H.W. (Department of Physics and Astronomy, Johns Hopkins University, Baltimore, Maryland 21218). *Review of Scientific Instruments;* **59**: No. 11, 2341-2350(Nov 1988).

The internal magnetic field in a magnetically confined plasma may be deduced from the analysis of circular polarization of spectral lines emitted by the plasma. The theory of the measurement and a detailed design of a polarimeter constructed to measure the poloidal field profile in the Texas Experimental Tokamak (TEXT) are presented. The instrument measures the difference between left-hand and right-hand circularly polarized line profiles, a quantity directly proportional to the magnetic field component in the direction of observation. The high throughput of the Fabry—Perot interferometer employed in this design, combined with efficient light-collecting optics and lock-in detection of the polarization signal, allows measurement of the fractional circular polarization of the magnetic dipole line Ti XVII 3834 A with an accuracy on the order of 10^{-3}. The line-of-sight averaged poloidal field is determined with uncertainty as small as 50 G. The line emission used in the present measurement is not well localized in the plasma, necessitating the use of a spatial inversion procedure to obtain the local values of the field.

2566 **Multichannel scintillator probe for energetic electron measurements.** Hokin, S.A.; Stek, P.C. (MIT Plasma Fusion Center, Cambridge, Massachusetts 02139). *Review of Scientific Instruments;* **59**: No. 11, 2366-2369(Nov 1988).

A compact multichannel scintillator probe is described, which has been used to make spectral measurements of energetic electron end-loss (E~400 keV)= from an electron cyclotron resonance-heated mirror plasma. The probe utilizes entrance foils of various thicknesses for energy discrimination, and photomultiplier tubes that are used in current mode with linear amplifiers for fast response (Δt~0.1 μs) or logarithmic amplifiers for wide dynamic range (10^{-8}—10^{-4} A). The probe is used to obtain spectra in the energy range 10—500 keV, and is sensitive to power densities above 0.1 mW/cm². The energy dependence of the response of a low-energy channel (sensitive to electrons above 10 keV) has been measured, and agrees very well with a calculation of the foil discrimination. Calibration results and sample data from the mirror plasma experiment are presented. Uses other than the measurement of electron end-loss in mirror experiments include measurement of runaway electron populations at the edge of tokamak plasmas and direction-sensitive measurement of high-energy electron populations in tokamak plasmas with lower hybrid current drive.

2567 **Alfven ion-cyclotron instability: Simulation theory and techniques.** Otani, N.F. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Journal of Computational Physics;* **78**: No. 2, 251-277(Oct 1988).

The numerical properties of a particle-ion, fluid-electron computer simulation code, used in the study of the parallel-propagating electromagnetic Alfven ion-cyclotron (AIC) instability, are examined. A numerical odd—even mode is suppressed by means of a two-timestep averaging methods. Excellent energy conservation is obtained by using a method similar to the Boris particle mover to advance the transverse fields. Linear growth rates obtained from the code differ substantially from those predicted by uniform Vlasov theory, here derived using a multifluid model. Short wavelengths in particular show substantial growth rates when damping is predicted, and additionally show strong linear mode coupling. Positive growth rates are even observed in the case of a Maxwellian ion distribution. Disagreement is also generally found among short-wavelength mode frequencies. These inconsistencies are resolved by taking into consideration general grid and discrete-particle effects of the simulation model. A theoretical study reveals a real, physical process by which an ion distribution may collisionlessly relax via short-wavelength AIC instabilities acting resonantly on small portions of the distribution function. This process is combined with a linear mode coupling theory and other characteristics of the AIC instability to explain all observed differences. Nonlinear short-wavelength saturation levels are also obtained and their relevance to other field-aligned, electromagnetic simulations is discussed. copyright 1988 Academic Press, Inc.

2568 **Fast alpha diagnostics using pellet injection.** Fisher, R.K.; Leffler, J.S.; Howald, A.M.; Parks, P.B. (GA Technologies, P.O. Box 85608, San Diego, CA (US)). *Fusion Technology;* **13**: No. 4, 536-542(May 1988).

Alpha particles will interact with the ablation cloud surrounding an injected pellet via charge-exchange (CX) and nuclear reactions. The use of these interactions to diagnose fast confined alphas in a fusion plasma is discussed. Measurement of helium neutrals from multiple CX interactions should allow determination of the incident alpha-energy distribution.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 625, 630, 630, 986, 1239, 2119, 2195, 2554, 2560, 2568

2569 (ACIESP—60-Vol.1, pp 59) **Random distribution of magnetic field lines in tokamaks.** Heller, M.V.; Caldas, I.L. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2570 (ACIESP—60-Vol.1, pp 65) **Research on reversed field pinch and compact toroids in Japan.** Oshiyama, H. (Kyoto Inst. of Tech. (Japan)). 1988. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88704411/JAW. (CONF-8808156—).

From 6. Japan-Brazil symposium on science and technology; Sao Paulo, Brazil (10 Aug 1988).

2571 **(AD-A—196953/4/XAB) Nonlinear-optical method for combining high-power laser beams in gases or plasmas. Final report.** Chivian, J.S.; Cantrell, C.D.; Glosson, C.A.; Cotten, W.D.; DiMarco, S.F. (LTV Missiles and Electronics Group, Dallas, TX (USA)). 31 May 1988. 93p. NTIS, PC A05/MF A01.

The purpose is to investigate concepts for laser-controlled optics via near-resonance nonlinear dispersion, so that a laser-induced index grating which is capable of high-power laser beam combining might be produced and demonstrated. The principle of coherent addition of several input laser beams into one output beam had been demonstrated by the use of binary phase gratings. Proper-

ly shaped phase gratings had been etched onto a solid surface, establishing that multiple laser beams can be combined into a single beam with good conversion efficiency. For high-power beams, the limited damage thresholds and maximum permissible thermal loading of solid-state devices encouraged a search for more satisfactory working media. Gases and plasmas appeared to offer better solutions as working media. It had been predicted that two laser fields of differing wavelengths interacting with a collision-dominated atomic or molecular system with three effective energy levels could influence one another in a nonreciprocal manner; the creation of and interaction with a grating via near-resonance nonlinear dispersion thus should provide a method for low power laser beams to create a grating in which other beams combined to form a high-power beam.

2572 **(CONF-871007—106) Design of a tritium-compatible vacuum pumping system for the Compact Ignition Tokamak.** Haines, J.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. Order Number DE89001573/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The conceptual design for the Compact Ignition Tokamak (CIT) vacuum pumping system features high-speed, magnetic-bearing turbomolecular pumps (TMPs), metal-sealed scroll pumps for roughing and backing, and all-metal valves and flange seals. Because the plasma chamber exhaust is handled in a throughput instead of hold-up fashion with no organic seal or lubricating materials exposed to the vacuum stream, inventories of tritium, which are vulnerable to release during an accident and which inhibit maintenance of the vacuum pumping equipment, are minimized. To achieve an initial base pressure of 1.3 {times} 10/sup {minus}6/ Pa in the plasma chamber, the design includes a large vacuum pumping duct and multiple high-speed TMPs arranged in two stages. The design studies discussed in this paper examine the feasibility and cost impact of providing a low-tritium-inventory, easily maintained vacuum pumping system for a deuterium-tritium (D-T) burning tokamak. 7 refs., 3 figs., 2 tabs.

2573 **(CONF-871007—118) Design of an ion cyclotron resonance heating system for the Compact Ignition Tokamak.** Yugo, J.J.; Goranson, P.L.; Swain, D.W.; Baity, F.W.; Vesey, R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. Order Number DE89001942/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Compact Ignition Tokamak (CIT) requires 10-20 MW of ion cyclotron resonance heating (ICRH) power to raise the plasma temperature to ignition. The initial ICRH system will provide 10 MW of power to the plasma, utilizing a total of six rf power units feeding six current straps in three ports. The systems may be expanded to 20 MW with additional rf power units, antennas, and ports. Plasma heating will be achieved through coupling to the fundamental ion cyclotron resonance of a ^{3}He minority species (also the second harmonic of tritium). The proposed antenna is a resonant double loop (RDL) structure with vacuum, shorted stubs at each end for tuning and impedance matching. The antennas are of modular, compact construction for installation and removal through the midplane port. Remote maintainability and the reactor-like operating environment have a major impact on the design of the launcher for this machine. 6 refs., 7 figs., 5 tabs.

2574 **(CONF-871007—120) Facilities design for TIBER II.** Thomson, S.L.; Blevins, J.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01. Order Number DE89001940/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

This paper describes the conceptual design of the reactor building and reactor maintenance building for the TIBER II tokamak. These buildings are strongly influenced by the reactor configuration, and their characterization allows a better understanding of the economic and technical implications of the reactor design. Key features of TIBER II that affect the facilities design are the small size and compact arrangement, the use of an external vacuum vessel, and the complete reliance on remote maintenance. The building design incorporates requirements for equipment layout, maintenance operations and equipment, safety, and contamination control. 4 figs.

2575 **(CONF-871007—121) Poloidal magnetics and divertor strike point control in the Compact Ignition Tokamak.** Strickler, D.J.; Peng, Y.K.M.; Sayer, R.O.; Jardin, S.C.; Rotolante, A.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01. Order Number DE89001939/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Compact Ignition Tokamak (CIT) is proposed to achieve short-pulse ignition and to study the physics of alpha-particle heating in a minimum-sized tokamak. The level of energy confinement required for ignition leads to a high-field (B/sub t/ = 10 T) device with a large plasma current (I/sub p/ = 9 MA). System studies have resulted in a baseline design with major radius R = 1.75 m, minor radius a = 0.55 m, elongation b/a = 2.0, and q = 3.5 where elongation and q are measured at the 95% flux surface. The poloidal field (PF) system for the CIT is designed for double-null divertor operation at a plasma current of 4.5 MA $\leqq$ I/sub p/ $\leqq$ 9.0 MA. Device physics specifications require that divertor operation be possible over a significant range of plasma profiles (e.g., 0.1 $\leqq$ β/sub p/ $\leqq$ 0.8 and 0.3 $\leqq$ l/sub i/ $\leqq$ 0.5) and plasma shapes (e.g., 1.6 $\leqq$ b/a $\leqq$ 2.0 at I/sub p/ = 6.3 MA) using mainly external PF windings. Further, it should be possible to vary, in a controlled manner, the points at which the separatrix flux surface intersects the divertor plates by using some combination of external coils and internal coils of modest current. These PF system flexibility and control requirements lead to several important problems in the area of computational magnetohydrodynamic (MHD) equilibria. Specifically, methods are presented for computing free-boundary equilibria with prescribed major radius, minor radius, PF volt-seconds, and divertor X-point coordinates or divertor strike-point coordinates. These methods are applied in the analysis of the CIT PF system. Equilibrium solutions satisfying the above criteria yield external PF coil currents and PF coil energies that vary over a large range for the specified range of plasma profiles. A numerical optimization technique is used to find solutions of minimum PF energy. 6 refs., 6 figs., 3 tabs.

2576 **(CONF-871007—123) Architecture of the ETR [experimental test reactor] systems code.** Reid, R.L.; Galambos, J.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01. Order Number DE89001932/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

TETRA, a tokamak systems code capable of modeling experimental test reactors (ETRs), was developed in a joint effort by participants of the fusion community. The first version of this code was constructed to model devices similar to the Tokamak Ignition/Burn Engineering Reactor (TIBER) in configuration and design. A major feature of this code is its ability to perform optimization studies. Future work will include broadening the scope of the code, particularly in the area of materials selection, to more accurately simulate tokamak configurations such as the Next European Torus (NET) and the Fusion Engineering Reactor (FER). 18 refs., 2 figs., 4 tabs.

2577 **(CONF-871007—124) Hot-spot measurements on the US-LCT coils in the IFSMTF.** Lue, J.W.; Dresner, L.; Fehling, D.T.; Lubell, M.S.; Luton, J.N.; McManamy, T.J.; Shen, S.S.; Wilson, C.T.; Wintenberg, R.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE89001928/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Hot-spot temperature during a quench is a major concern for superconducting coil protection. If the allowable temperature can be increased, then the dump time constant can be made longer and the dump voltage correspondingly reduced. Thus, the insulation requirement can be less stringent and the dump operation can be safer. The US-made Large Coil Task (LCT) coils are all instrumented with heaters, resistive or inductive. The hot-spot tempera-

tures of these coils were found by repeatedly driving the conductor normal with the heaters at increasing coil currents until the normal zone propagated. The resulting hot-spot temperature was measured by the resistance of the conductor over a fixed length. The effect of dump time delay on the hot-spot temperature was also investigated. The results are compared with calculations based on various assumptions. 4 refs., 7 figs.

2578 **(CONF-871007—125) Configuration development of a hydraulic press for preloading the toroidal field coils of the Compact Ignition Tokamak.** Lee, V.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. Order Number DE89001927/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Fusion Engineering Design Center (FEDC) is part of a national design team that is developing the conceptual design of the Compact Ignition Tokamak (CIT). To achieve a compact device with the minimum major radius, a vertical preload system is being developed to react the vertical separating force normally carried by the inboard leg of the toroidal field (TF) coils. The preload system is in the form of a hydraulic press. Challenges in the design include the development of hydraulic and structural systems for very large force requirements, which could interface with the CIT machine, while allowing maximum access to the top, bottom, and radial periphery of the machine. Maximum access is necessary for maintenance, diagnostics, instrumentation, and control systems. Materials used in the design must function in the nuclear environment and in the presence of high magnetic fields. The structural system developed is an arrangement in which the CIT device is installed in the jaws of the press. Large built-up beams above and below the CIT span the machine and deliver the vertical force to the center cylinder formed by the inboard legs of the TF coils. During the conceptual design study, the vertical force requirement has ranged between 25,000 and 52,000 t. The access requirement on top and bottom limits the width of the spanning beams. Nonmagnetic steel materials are also required because of operation in the high magnetic fields. In the hydraulic system design for the press, several options are being explored. These range from small-diameter jacks operating at very high pressure [228 MPa (33 ksi)] to large-diameter jacks operating at pressures up to 69 MPa (10 ksi). Configurations with various locations for the hydraulic cylinders have also been explored. The nuclear environment and maintenance requirements are factors that affect cylinder location. This paper presents the configuration development of the hydraulic press used to vertically preload the CIT device.

2579 **(CONF-871007—126) Design considerations for ITER [International Thermonuclear Experimental Reactor] toroidal field coils.** Kalsi, S.S.; Lousteau, D.C.; Miller, J.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01. Order Number DE89001926/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The International Thermonuclear Experimental Reactor (ITER) is a new tokamak design project with joint participation from Europe, Japan, the Union of Soviet Socialist Republics (USSR), and the United States. This paper describes a magnetic and mechanical design methodology for toroidal field (TF) coils that employs Nb{sub 3}Sn superconductor technology. Coil winding is sized by using conductor concepts developed for the US TIBER concept. The nuclear heating generated during operation is removed from the windings by helium flowing through the conductor. The heat in the coil case is removed through a separate cooling circuit operating at approximately 20 K. Manifold concepts are presented for the complete coil cooling system. Also included are concepts for the coil structural arrangement. The effects of in-plane and out-of-plane loads are included in the design considerations for the windings and case. Concepts are presented for reacting these loads with a minimum amount of additional structural material. Concepts discussed in this paper could be considered for the ITER TF coils. 6 refs., 5 figs., 1 tab.

2580 **(CONF-880364—36) ATF [Advanced Toroidal Facility] data management.** Kannan, K.L.; Baylor, L.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01. Order Number DE89001872/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Data management for the Advanced Toroidal Facility (ATF), a stellarator located at Oak Ridge National Laboratory (ORNL), is provided by DMG, a locally developed, VAX-based software system. DMG is a data storage and retrieval software system that provides the user interface to ATF raw and analyzed data. Data are described in terms of data models and data types and are organized as signals into files, which are internally documented. The system was designed with user accessibility, software maintainability, and extensibility as primary goals. Extensibility features include compatibility with ATF as it moves from pulsed to steady-state operation and capability for use of the DMG system with experiments other than ATF. DMG is implemented as a run-time library of routines available as a shareable image. General-purpose and specialized data acquisition and analysis applications have been developed using the DMG system. This paper describes the DMG system and the interfaces to it. 4 refs., 2 figs.

2581 **(CONF-880812—18) Influence of dump voltage and allowable temperature rise on stabilizer requirements in superconducting coils.** Schwenterly, S.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01. Order Number DE89001684/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

A superconducting winding must have enough stabilizer to satisfy two sets of criteria. During normal operation, the amount of stabilizer must be large enough either to make the coil unconditionally stable or to give a certain desired stability margin. Once a dump occurs, the amount of stabilizer must be large enough to carry the current without generating excessive dump voltages or allowing the winding to exceed a certain maximum temperature (and maximum pressure, in the case of force-cooled coils). The voltage criterion often dominates for very large coil systems, but it is frequently ignored in initial design studies. This paper gives some simple relations between the dump voltage and the stored energy, temperature rise, and coil geometry that are useful in scooping the required amount of stabilizer. Comparison with some recently proposed fusion magnet system designs indicates that excessive dump voltages could result in some cases. High-temperature superconductors may require more stabilizer than the conventional alloys. Calculations with simple model coil systems indicate how trade-offs between various coil parameters affect the dump voltage. 12 refs., 1 fig., 1 tab.

2582 **(CONF-881002—20) Simplified eight-shot pneumatic pellet injector for plasma fueling applications on the Princeton Beta Experiment [PBX] and on the Advanced Toroidal Facility [ATF].** Schuresko, D.D.; Cole, M.J.; Fisher, P.W.; Qualls, A.L.; Bauer, M.L.; Wysor, R.B.; Lickliter, P.; Webster, D.J.; Argo, B.E.; Combs, S.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 17p. NTIS, PC A03. Order Number DE89002199/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

Plasma fueling via injection of solid hydrogenic pellets has expanded the operating range for tokamaks and stellarators to higher densities than attainable with gas puffing. Pellet injection has also resulted in improved plasma energy confinement in tokamak discharges for which the pellet or pellets penetrate deep into the plasma core. The eight-shot pneumatic pellet injector described herein has been developed for use on the Princeton Beta Experiment (PBX) and on the Advanced Toroidal Facility (ATF) for routine plasma fueling and for confinement optimization studies. The injector is based upon the so-called "pipe-gun" concept, which generates deuterium and hydrogen pellets by direct condensation in the gun barrel tubes, segments of which are cooled below the hydrogen triple point temperature by contact with a liquid helium cooled block. Control of the pellet length is achieved both by regulating

the deuterium fill pressure and by establishing temperature gradients along the barrel tubes. This injector features eight independent gun barrel assemblies mounted around the perimeter of a single cold block, each coupled to an ORNL-designed fast propellant valve. Thus, the injector is capable of injecting arbitrarily programmable sequences of up to eight pellets of sizes ranging from 1 mm to 3 mm at speeds up to 1500 m/s. 10 refs., 8 figs.

2583 **(CONF-881120—12) Response of materials to high heat fluxes during operation in fusion reactors.** Hassanein, A.M. (Argonne National Lab., IL (USA)). Jul 1988. Contract W-31109-ENG-38. 7p. NTIS, PC A02. Order Number DE89000616/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

Very high energy deposition on first wall and other components of a fusion reactor is expected due to plasma instabilities during both normal and off-normal operating conditions. Off-normal operating conditions result from plasma disruptions where the plasma loses confinement and dumps its energy on the reactor components. High heat flux may also result from normal operating conditions due to fluctuations in plasma edge conditions. This high energy dump in a short time results in very high surface temperatures and may consequently cause melting and vaporization of these materials. The net erosion rates resulting from melting and vaporization are very important to estimate the lifetime of such components. The response of different candidate materials to this high heat fluxes is determined for different energy densities and deposition times. The analysis used a previously developed model to solve the heat conduction equation in two moving boundaries. One moving boundary is at the surface to account for surface recession due to vaporization and the second moving boundary is to account for the solid-liquid interface inside the material. The calculations are done parametrically for both the expected energy deposited and the deposition time. These ranges of energy and time are based on recent experimental observations in current fusion devices. The candidate materials analyzed are stainless steel, carbon, and tungsten. 8 refs., 9 figs.

2584 **(CONF-881129—3) A method for vertical electromagnetic moldless casting of steel.** Turner, L.R.; Lari, R.J.; Praeg, W.F. (Argonne National Lab., IL (USA)). May 1988. Contract W-31109-ENG-38. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88011950/JAW.

From International symposium on casting near net shape products; Honolulu, HI, USA (13 Nov 1988).

Several approaches have been studied for the vertical casting of thin (3 mm-8 mm) sheets of steel. Each approach employs electromagnetic (EM) forces, avoids the need for contact between the solidifying steel and a solid mold. The most promising approach uses a high-frequency (HF:>100 kHz) oval solenoid magnet to provide containment of the liquid steel and a low-frequency (LF:{approximately}60 Hz) traveling field, similar to the double-sided linear induction pump, to provide levitation. The low field level of the solenoid and the low frequency of the levitation magnet result in acceptably low EM heating of the steel. The LF field penetrates the steel and provides a body force exactly counteracting the force of gravity everywhere except near the edges of the solidifying sheet. Additional HF traveling field magnets augment the levitation force near the edges but generate more EM heating. Other means of extending the levitating force to the edge and other approaches using stationary or traveling fields have also been studied. 4 refs., 4 figs.

2585 **(CONF-881151—15) Neutral particle beam intensity controller.** Dagenhart, W.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01. Order Number DE89001353/JAW.

From International conference on the application of accelerators in research and industry; Denton, TX, USA (7 Nov 1988).

A method is proposed in which an amplitude-modulated, rotating magnetic field is applied to an accelerated ion beam in a gas neutralizer to defocus the resultant neutral and ion beam in a controlled manner to control the intensity of the neutral beam along the beam axis at constant beam energy. Adjustments in the gas pressure determine the fraction of ions that is neutralized. The rotating magnetic field alters the orbits of the ions in the gas neutralizer before they are neutralized. By adjusting the gas pressure and the amplitude of the rotating magnetic field, one can control the fraction of neutral and ion particles transmitted out of the neutralizer along the central beam axis to a fusion device or other application. This method can also be used for applications where no neutralization gas is used and thus most of the beam remains in the ion state. The defocused neutral or ion particles are sprayed onto an actively cooled beam dump, which intercepts the deflected particles. The beam dump has a central opening for passage of the remaining beam along the central axis of the beam line. 4 refs., 4 figs.

2586 **(CONF-8711195—3) Ex-vessel remote maintenance for the Compact Ignition Tokamak.** Spampinato, P.T.; Macdonald, D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01. Order Number DE89001938/JAW.

From American Nuclear Society winter meeting; Los Angeles, CA, USA (15 Nov 1987).

The use of deuterium-tritium (D-T) fuel for operation of the Compact Ignition Tokamak (CIT) requires the use of remote handling technology to carry out maintenance operations on the machine. These operations consist in removing and repairing such components as diagnostic modules by using remotely operated maintenance equipment. The major equipment being developed for maintenance external to the plasma chamber includes a bridge-mounted manipulator system for test cell operations, decontamination (decon) equipment, hot cell equipment, and solid-radiation-waste-handling equipment. Wherever possible, the project will use commercially available equipment. Several areas of the maintenance system design were addressed in fiscal year (FY) 1987, including conceptual designs of manipulator systems, the start of a remote equipment research and development (R&D) program, and definition of the hot cell, decon, and equipment repair facility requirements. R and D work included preliminary demonstrations of remote handling operations on full-size, partial mock-ups of the CIT machine at the Oak Ridge National Laboratory (ORNL) Remote Operations and Maintenance Development (ROMD) Facility. 1 ref., 6 figs.

2587 **(CONF-8806250—2) ITER pellet fueling.** Houlberg, W.A. (Oak Ridge National Lab., TN (USA)). 18 Jun 1988. Contract AC05-84OR21400. 11p. NTIS, PC A03/MF A01. Order Number DE89001200/JAW.

From ITER fueling assessment; Garching, F.R. Germany (21 Jun 1988).

This paper discusses: ITER fueling issues; ITER pellet sizes, ablation and penetration; and ITER pellet injector requirements. 5 refs., 6 figs.

2588 **(DOE/ER/53101—T1) Compact torus research: Final technical report, February 1, 1980-January 31, 1986.** Rostoker, N.; Katzenstein, J. (California Univ., Irvine (USA). Dept. of Physics). 1986. Contract AS03-80ER53101. 19p. NTIS, PC A03/MF A01. Order Number DE89002253/JAW.

This paper discusses compact torus research on the following topics: On the Cost Effectiveness of Intense, Repetitively Pulsed Ion Beams as Reactor Ignitors; and Injection and Trapping of Intense Neutralized Ion Beams in Closed Magnetic Configuration. 20 refs., 2 figs.

2589 **(DOE/ER/53192—8) Experimental studies on the Auburn Torsatron: Annual progress report.** Gandy, R.F.; Swanson, D.G. (Auburn Univ., AL (USA). Dept. of Physics). Oct 1988. Contract FG05-85ER53192. 8p. NTIS, PC A02/MF A01. Order Number DE89001906/JAW.

This paper discusses research programs in progress on the Auburn Torsatron. Topic areas covered are: ICR heating results; Compact Auburn Torsatron design; Compact Auburn Torsatron construction; and collaborations. (LSP)

2590 **(DOE/ET/51013—244) Reconstruction of vacuum flux surfaces from diagnostic measurements in a tokamak.** Hakkarainen, S.P.; Freidberg, J.P. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 2 Dec 1987. Contract AC02-78ET51013. 66p. (PFC/RR—87-22). NTIS, PC A04/MF A01. Order Number DE89001798/JAW.

The shape of a tokamak plasma is determined from measurements of the magnetic flux and one component of the poloidal magnetic field at the vacuum chamber wall. The problem is solved by an application of the Vector Green's theorem for the poloidal flux function, allowing a formulation which overcomes the inherent ill-posedness of the problem while maintaining the computational speed necessary for between shot analysis. The expansion functions are one-dimensional Fourier Transforms in a poloidal-angle-like variable along the direction of the wall. An error analysis is presented that shows the existence of an optimal number of terms in the Fourier sum to maximize the accuracy of the solution. It is also shown that even with random measurement errors, the solution has the same accuracy as the input data from the diagnostic measurements, at least if the maximum error is less than 5%. 11 refs., 17 figs., 2 tabs.

2591 **(DOE/ET/51013—255) Methods for the design and optimization of shaped tokamaks.** Haney, S.W. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). May 1988. Contract AC02-78ET51013. 243p. (PFC/RR—88-12). NTIS, PC A11/MF A01. Order Number DE89001794/JAW.

Two major questions associated with the design and optimization of shaped tokamaks are considered. How do physics and engineering constraints affect the design of shaped tokamaks? How can the process of designing shaped tokamaks be improved? The first question is addressed with the aid of a completely analytical procedure for optimizing the design of a resistive-magnet tokamak reactor. It is shown that physics constraints---particularly the MHD beta limits and the Murakami density limit---have an enormous, and sometimes, unexpected effect on the final design. The second question is addressed through the development of a series of computer models for calculating plasma equilibria, estimating poloidal field coil currents, and analyzing axisymmetric MHD stability in the presence of resistive conductors and feedback. The models offer potential advantages over conventional methods since they are characterized by extremely fast computer execution times, simplicity, and robustness. Furthermore, evidence is presented that suggests that very little loss of accuracy is required to achieve these desirable features. 94 refs., 66 figs., 14 tabs.

2592 **(EUR—10728) Environmental aspects of fusion reactors 1985.** Casini, G; Ponti, C.; Rocco, P. (ed.). (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 111p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88780125/JAW.

The aspects of the environmental impact as expected from future fusion reactors are reviewed. The radioactive inventories consist in tritium and neutron-induced radioactivity in the structures. An analysis is performed of the radioactive releases from the different plant's systems in normal and accident conditions and typical emissions to the ambient are defined. Information is given on the waste management problems. Two appendixes give general information on tritium and safety guidelines.

2593 **(GA-A—18971) The use of networking in the DIII-D data acquisition and analysis computer systems.** McHarg, B.B., Jr. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 8p. (CONF-871007—110). NTIS, PC A02/MF A01. Order Number DE89001812/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

DIII-D is a large plasma physics and fusion research experiment funded by the Department of Energy. Each shot of the experiment is currently generating nearly 20 megabytes of data which is acquired primarily by MODCOMP Classic computer systems and analyzed by DEC VAX computer systems. Shots are repeated about once every 10 minutes with 40--50 shots per operating day. As the data size and need for data access has grown, the computer systems have evolved from distinct systems to loosely coupled systems to, in some cases, tightly coupled systems. The networking or connectivity of the systems has become an integral and necessary part of the data acquisition and analysis process. The MODCOMP systems utilize networking software to allow one computer to activate tasks on another computer and to transfer data between computers. A Network Systems Hyperchannel link is used for data transfer between MODCOMP and VAX computers. The heaviest use of networking is between the VAX systems which are all connected by DECnet. Networking software have been developed to provide transparent remote user data access, remote printing, the running of tasks on other systems, and the collection of raw and calculated results from other systems. 7 refs., 4 figs.

2594 **(GA-A—18973) A compact, multiple fiber-optic bundle viewing system.** Evanko, R.G. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 7p. (CONF-871007—115). NTIS, PC A02/MF A01. Order Number DE89001808/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The details of the design and fabrication of a fiber-optic viewing system are presented. The system was designed for the Thomson scattering profile diagnostic to view discrete plasma points along the line defined by a vertical ruby laser beam inside the vacuum vessel of the DIII-D tokamak. The system is located just outside a vessel port looking through a multiple lens assembly. Fifty-nine fiber-optic bundle locations spaced within a total height of 26.92 cm allow up to 59 discrete plasma points to be observed along a vertical height of 127-152 cm within the vacuum vessel. The essential component of the design is the mechanical mount which holds the viewing end of the fiber bundles. The mount prevents direct handling of the bundles, thus eliminating any damage to the fibers, and allows the bundles to be precisely positioned in any of the 59 locations with relative ease. The use of Computer Aided Design (CAD) and the required precision of the design is discussed. 6 figs., 1 tab.

2595 **(GA-A—18975) The ground-fault detection system for DIII-D.** Scoville, J.T.; Petersen, P.I. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 8p. (CONF-871007—116). NTIS, PC A02/MF A01. Order Number DE89001809/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

This paper presents a discussion of the ground-fault detection systems on the DIII-D tokamak. The subsystems that must be monitored for an inadvertent ground include the toroidal and poloidal coil systems, the vacuum vessel, and the coil support structures. In general, one point of each coil is tied to coil/power supply ground through a current limiting resistor. For ground protection the current through this resistor is monitored using a dynamically feedback balanced Hall probe transducer from LEM Industries. When large inductive currents flow in closed loops near the tokamak, the result is undesirable magnetic error fields in the plasma region and noise generation on signal cables. Therefore, attention must be paid to avoid closed loops in the design of the coil and vessel support structure. For DIII-D a concept of dual insulating breaks and a single-point ground for all structure elements was used to satisfy this requirement. The integrity of the support structure is monitored by a system which continuously attempts to couple a variable frequency waveform onto these single-point grounds. The presence of an additional ground completes the circuit resulting in current flow. A Rogowski coil is then used to track the unwanted ground path in order to eliminate it. Details of the ground fault detection circuitry, and a description of its operation will be presented. 2 refs., 7 figs.

2596 **(GA-A—18989) Modification of the DIII-D neutral beam power systems for operation of the common long pulse source.** Kellman, D.H.; Hong, R.; Kim, J.; Nerem, A.; Phillips, J.C. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 8p. (CONF-871007—114). NTIS, PC A02/MF A01. Order Number DE89001806/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Conversion from the short pulse ion source to the common long pulse source in the DIII-D neutral beam injectors required appropriate power system modifications. The increased beam pulse length from 0.5 sec to 5 sec necessitated development of upgraded cooling of the resistive divider for the tetrode accelerator. The new electrical connection scheme required reconfiguration of the power transmission line. Control of the filament and arc power supplies was tailored to best serve the emission-limited discharge of the plasma generator. A different method for the initial formation of ion beams had to be developed. Details of the modifications made, and their underlying principles are presented along with the ongoing development for smoother operation of high power ion beams. 5 refs., 2 figs.

2597 **(GA-A—18990) Microprocessor-based neutron counter for DIII-D.** Glad, A.S. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 8p. (CONF-871007—111). NTIS, PC A02/MF A01. Order Number DE89001810/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The operating environment for the DIII-D tokamak places requirements on health safety neutron monitoring which differ from previous health safety monitoring used on Doublet III. The new operating environment requires monitoring to include neutrons generated during tokamak shots and neutrons generated during neutral beam conditioning. Since neutral beam conditioning is performed asynchronously to the tokamak operation, a system of continuous monitoring is required. The original method for monitoring neutrons was performed using the DIII-D diagnostic data computer system, since only shot-related information was necessary. To perform continuous monitoring, a separate microcomputer-based system was implemented. The system was designed to use an IBM PC AT interfacing the neutron detectors through a GPIB bus with a single CAMAC crate. The software was selected to perform multi-tasking utilizing the concurrent PC DOS operating system with all applications developed in the C language. The primary requirements included monitoring the neutrons continuously, ensuring that health safety limits were not exceeded, and prevention of further operation when a limit was approached. The purpose of this paper is three-fold. First, the system will be described in terms of the hardware configuration and the software methods used collecting, managing, and displaying the data. Included in the description will be the justifications and trade-offs on selecting the exact hardware and software used. Second, the problems encountered in implementation due to non-compatible hardware and software will be covered. This discussion will focus on problems which are difficult to anticipate without direct experience with the exact hardware and software configuration. Third, guidelines which can be used to prevent some of the compatibility problems that can occur will be discussed. 4 figs.

2598 **(GA-A—18991) Permeability measurement of ferromagnetic components in the DIII-D beamlines.** Kim, J.; Colleraine, A.P.; Haskovec, J.S. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 8p. (CONF-871007—109). NTIS, PC A02/MF A01. Order Number DE89001813/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

In upgrading the neutral beamline components for the DIII-D tokamak, a combination of old ferromagnetic components and newly fabricated ones were employed to shield the ion sources and ion beam paths from the stray magnetic fields of the tokamak. Effects of heat treatment and mechanical impacts on these components were checked by measurement of B-H characteristics of test rings and/or rectangular loops formed with actual parts. Measurement techniques and results are described. 7 refs., 6 figs., 1 tab.

2599 **(GA-A—18994) Fault analysis of the DIII-D neutral beam safety interlock system.** Phillips, J.C.; Colleraine, A.P.; Haskovec, J.S.; Hong, R.; Kim, J.; Sleaford, B.W.; Tooker, J.F.; Wight, J.J. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 9p. (CONF-871007—112). NTIS, PC A02/MF A01. Order Number DE89001811/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The DIII-D neutral beam injection systems (NBIS) at GA Technologies rely on a substantial array of control and instrumentation for routine operation. Functions include shot sequencing, power supply control, vacuum control, and valve control, long with interlocks for safequarding personnel and equipment. Failures resulting from improper operation of the neutral beamlines, their power supplies, and supporting services have the potential to cause extensive damage to personnel, equipment, and beamline components, as well as delay of the experimental schedule. This paper will address only equipment and component failures. Intelligence and control are distributed over dissimilar types of equipment in separate locations. An analysis has been made of the possible failure modes of the subsystems and the interlocking of systems and operations. This has helped us to improve the design of the safety interlock system and to minimize the risk to the NBIS project. The analysis technique will be presented and possible outcomes of typical failure modes explored. 5 refs., 2 figs.

2600 **(GA-A—18997) Status and near-term plans for DIII-D.** Davis, L.G.; Callis, R.W.; Luxon, J.L.; Stambaugh, R.D. (General Atomics Co., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044. 10p. (CONF-871007—113). NTIS, PC A02/MF A01. Order Number DE89001807/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The DIII-D tokamak at GA Technologies began plasma operation in February of 1986 and is dedicated to the study of highly non-circular plasmas. High beta operation with enhanced energy confinement is paramount among the goals of the DIII-D research program. Commissioning of the device and facility has verified the design capability including coil and vessel loading, volt-second consumption, bakeout temperature, vessel armor, and neutral beamline thermal integrity and control systems performance. Initial experimental results demonstrate the DIII-D is capable of attaining high confinement (H-mode) discharges in a divertor configuration using modest neutral beam heating or ECH. Record values of I/sub p/ aB/sub T/ have been achieved with ohmic heating as a first step toward operation at high values of toroidal beta and record values of beta have been achieved using neutral beam heating. This paper summarizes results to date and gives the near term plans for the facility. 13 refs., 6 figs., 1 tab.

2601 **(GA-A—19026) Compact Ignition Tokamak vacuum vessel closure joint R & D.** Hurn, T.; Fisher, M.; Gallix, R.; Hager, E.R.; Boyles, L.; Mishler, H.; Wylde, G. (SEE CODE- 9524084 GA Technologies, Inc., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER53158. 4p. (CONF-871007—117). NTIS, PC A02/MF A01. Order Number DE89001825/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Based on the current conceptual design, final closure of the Compact Ignition Tokamak (CIT) vacuum vessel requires two in-situ welds in the poloidal direction. Welding must be performed from the inside of the vacuum vessel because of limited access. The ability to control and predict the amount of weld distortion and the ability to ensure the long-term reliability of these welded joints under cyclic loading is critical. R & D programs are in progress to investigate these issues as well as develop specialized welding equipment to produced these welds. The current status and results are presented. 1 ref., 8 figs., 1 tab.

2602 **(GA-A—19202) Development, installation, and initial operation of DIII-D graphite armor tiles.** Anderson, P.M.; Baxi, C.B.; Reis, E.E.; Smith, J.P.; Smith, P.D. (General Atomics Co., San Diego, CA (USA)). Apr 1988. Contract AC03-84ER51044. 12p. (CONF-880417—24). NTIS, PC A03/MF A01. Order Number DE89001439/JAW.

From International symposium on nuclear fusion technology; Tokyo, Japan (10 Apr 1988).

An upgrade of the DIII-D vacuum vessel protection system has been completed. The ceiling, floor, and inner wall have been armored to enable operation of CIT-relevant doublenull diverted plasmas and to enable the use of the inner wall as a limiting surface. The all- graphite tiles replace the earlier partial coverage armor configuration which consisted of a combination of Inconel tiles and graphite brazed to Inconel tiles. A new all-graphite design concept was chosen for cost and reliability reasons. The 10 minute duration between plasma discharges required the tiles to be cooled by conduction to the water-cooled vessel wall. Using two and three- dimensional analyses, the tile design was optimized to minimize thermal stresses with uniform thermal loading on the plasma-facing surface. Minimizing the stresses around the tile hold-down feature and eliminating stress concentrators were emphasized in the design. The design of the tile fastener system resulted in sufficient hold-down forces for good thermal conductance to the vessel and for securing the tile against eddy current forces. The tiles are made of graphite, and a program to select a suitable grade of graphite was undertaken. Initially, graphites were compared based on published technical data. Graphite samples were then tested for thermal shock capacity in an electron beam test facility at the Sandia National Laboratory (SNLA) in Albuquerque, New Mexico, USA. 4 refs., 6 figs.

2603 **(IPP—4/235) Systems analysis of INTOR-like designs based on a simplified rescaling method.** Knobloch, A.F. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Apr 1988. 100p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755414/JAW.

On the basis of a simplified non-optimizing rescaling method the INTOR-like next-step tokamak reactor designs, NET-DN, FER, TIBER II and OTR (as of March 1987), are analysed and compared with each other and with INTOR, as of Phase Two A Part 2, on a common basis in order to understand their characteristic differences deriving from the respective input assumptions. Always on the basis of a certain confinement scaling, this is done with different approaches. It is generally seen that the physics input assumptions and their respective combination play a major role, with the maximum toroidal field and the central solenoid radius also being influential. Depending on the set of physics/engineering input assumptions in combination with the set of design parameters required, a certain domain in multiparamter space becomes accessible from which a choice could be made (e.g. to optimize cost for a certain fusion power). The results referring to typical INTOR assumptions and requirements were also contributed to the INTOR Phase Two A Part 3 workshop. An outlook is added on what a next-step parameter set could look like on the basis of modified physics input assumptions as adopted towards the end of the INTOR studies and no longer taken into account by them.

2604 **(IPPJ—810) Ignition of deuterium based fuel cycles in a high beta system.** Hirano, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1987. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780130/JAW.

A steady state self-consistent plasma modeling applied to a system having $< 4b >$ close to unity, such as FRC or like, is found to be quite effective in solving the problems independently of any anomalous process and proves the existence of ignited state of deuterium based fuel cycles. The temperature ranges that the plasma falls into ignited state are obtained as a function of relative feeding rates of tritium and ^{3}He to deuterium's. We find pure DD cycle will not ignite so that ^{3}He or/and tritium must be added as catalyzer to achieve ignition. Standing on the points to construct a cleaner system yielding smaller amount of 14 MeV neutrons and to burn the fuel in steady state for long period of time, we have confirmed superiority of the complex composed of the master reactor of ^{3}He-Cat.D cycle (catalyzed DD cycle reinjecting only fusion produced ^{3}He) and the satellite reactor of ^{3}He enriched D^{3}He cycle. In case storage of tritium for ^{3}He by 4b/sup minus/ decay is turned out not to be allowed environmentally, we may utilize conventional catalyzed DD cycle although 14 MeV neutron yields will be increased by 35% over the complex. It is demonstrated that advanced fuel cycle reactors can be very simple in constructions and compact in size such that the field strength and the plasma volume of the order of JT-60's may be enough for 1000 MW power plant.

2605 **(IPPJ—816) Safety analysis and evaluation methodology for fusion systems.** Fujii-e, Y.; Kozawa, Y.; Namba, C. (Tokyo Inst. of Tech., Japan). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1987. 282p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780111/JAW.

Fusion systems which are under development as future energy systems have reached a stage that the break even is expected to be realized in the near future. It is desirable to demonstrate that fusion systems are well acceptable to the societal environment. There are three crucial viewpoints to measure the acceptability, that is, technological feasibility, economy and safety. These three points have close interrelation. The safety problem is more important since three large scale tokamaks, JET, TFTR and JT-60, start experiment, and tritium will be introduced into some of them as the fusion fuel. It is desirable to establish a methodology to resolve the safety- related issues in harmony with the technological evolution. The promising fusion system toward reactors is not yet settled. This study has the objective to develop and adequate methodology which promotes the safety design of general fusion systems and to present a basis for proposing the R and D themes and establishing the data base. A framework of the methodology, the understanding and modeling of fusion systems, the principle of ensuring safety, the safety analysis based on the function and the application of the methodology are discussed. As the result of this study, the methodology for the safety analysis and evaluation of fusion systems was developed. New idea and approach were presented in the course of the methodology development. (Kako, I.).

2606 **(IPPJ—825) Determination of pitch angles of magnetic field lines in tokamak with obliquely injected helium beam.** Mohri, Akihiro. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1987. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780112/JAW.

Pitch angles of magnetic field lines or q-profile in high density tokamak can be determined by a new method proposed here. Blobs of monoenergetic helium beam with different velocities are injected into the tokamak obliquely to the toroidal direction on a poloidal plane x. Produced He^+ ions move nearly along magnetic field lines, and their front emitting a HeII line crosses a different sight plane and forms a curve on it. Optically measured shift of the curve from x leads to the distribution of pitch angle after correction of perpendicular drift motion of He^+ ions using the velocity dependence of the drift.

2607 **(IPPJ—835) Electron beam effect in the Uramoto-type sheet plasma as a H/sup {minus}//D/sup {minus}/ ion source of volume production.** Uramoto, Joshin. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jul 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780122/JAW.

When a cylindrical plasma produced along a uniform magnetic field is shaped into a sheet plasma (the Uramoto-type sheet plasma) by arranging two rectangular permanent magnets, a local voltage above 30 V is generated between the cylindrical plasma and the sheet plasma, and it accelerates electrons producing an electron beam sheet. Consequently, a H/sup {minus}/ ion current extracted from outside of the sheet plasma increases dramatically. From this experimental fact, we expect that vibrationally excited H_2 molecules are produced by the high density, high energy (> 30 eV) electron beam sheet. Comparing with bucket (multi-cusp) type plasmas, reflex discharge (Penning) type plasmas and cylindrical plasmas of slit type sheet plasmas along uniform magnetic field, this characteristic of the sheet plasma much improves a gas efficiency and a discharge power efficiency as a H/sup {minus}//D/sup {minus}/ ion source of volume production.

2608 (IPPJ—859, pp 1-16) **Analysis for fuel implosion in ICF target and pellet gain.** Niu, Keishiro; Aoki, Takayuki; Takeda, Hiroshi. (Tokyo Inst. of Tech. (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

A power plant to extract 1 GW electric output power is proposed. After the properties of the DT fuel is examined, the compression and the heating of the fuel in the target due to the implosion motion is analyzed. The optimized parameters of the target is investigated for extracting the maximum fusion energy.

2609 (IPPJ—859, pp 17-37) **Numerical analysis for effects of irradiation nonuniformities on target implosion.** Takeda, Hiroshi; Niu, Keishiro. (Tokyo Inst. of Tech. (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

Effects of irradiation nonuniformities on target implosion and ignition conditions for inertial-confinement fusion with ion beams are studied by using a 2-dimensional code. The following results are then obtained. When the beam energy is 5 MJ which is 1.6 times the threshold beam energy (=3.2 MJ) in the spherical symmetric case, ignition occurs if the peak-to-valley nonuniformity rate is smaller than 0.05. On the other hand, this value rises up to 0.1 when the beam energy is 7 MJ, i.e., it is 2.2 times the threshold beam energy in the spherical symmetric case. Furthermore, the ignition condition is the severest for the nonuniformity with the largest spatial scale.

2610 (IPPJ—859, pp 38-45) **Development of electromagnetic PIC code for LIB diode.** Ozaki, Katsuhiko; Niu, Keishiro. (Tokyo Inst. of Tech. (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

We are developing a 2.5 - dimensional particle - in - cell code to design high intensity LIB diode for inertial confinement fusion. The fundamental equations consist of three wave equations, one Poisson equation for determining the electromagnetic field and Newton - Lorentz equations for moving particles. In this code, cylindrical coordinate is used. The first step, this PIC Code tries to simulate a simple model which is parallel circular plane diode and to investigate ion current density at cathode.

2611 (IPPJ—859, pp 46-55) **Kinetic theoretical analysis for propagation of rotating ion beam in ICF.** Kaneda, T.; Niu, Keishiro. (Tokyo Inst. of Tech. (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

It is proposed that self-magnetic field of the beam can stabilize and pinch itself, without complete neutralization of the beam current. This situation is achieved in the back ground plasma which density is about 1/10 of the beam. The beam produces the strong azimuthal self-magnetic field by the axial motion. This field makes the beam pinch. The axial self-magnetic field is induced by the beam azimuthal motion and stabilizes the beam propagation. In this paper, the rotating light ion beam is discussed on the basis of kinetic theory. The velocity distribution function for the beam ions f/sub b0/ is obtained as an exact solution of the Vlasov-Maxwell equation for the steady state. That is, f/sub b0/ is an arbitrary function with respect to Hamiltonian H, canonical angular momentum P/sub θ/ and canonical axial momentum P/sub z/ ; f/sub b0/ = f/sub b0/ (H,P/sub θ/, P/sub z/). Here, the subscript "0" denotes the steady state. The macroscopic physical quantities are obtained by integration in v-space. Hence, in order to obtain the steady state solution of beam-plasma system, these equations must be solved numerically with Maxwell equations simultaneously. The distribution function f/sub b0/ is assumed by considering the condition to extract the beam in the diode.

2612 (IPPJ—859, pp 56-77) **Hybrid particle simulation for focusing of rotating and propagating LIB.** Aoki, Takayuki; Niu, Keishiro. (Tokyo Inst. of Tech. (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

The focusing processes of a rotating and propagating light ion beam in the drift region are studied numerically by using a hybrid particle code. Initially an intense ion beam with the current density of 8 kA/cm/sup 2/ and the total current of 2.5 MA, which is extracted from the diode, passes through the applied magnetic field to make the beam rotate in the azimuthal direction. The beam is focused owing to the anode geometry and the induced self-magnetic field. The phenomena of the beam focusing strongly depend on both the background plasma pressure of the drift region and the applied magnetic field. In the case that the plasma pressure is 3.0 Torr and the 0.2-Tesla magnetic field is applied in the distance of 2.0 cm, the self-magnetic field is induced in the vicinity of the focal spot, and the rotating and propagating beam with the intensity of 108 TW/cm/sup 2/ and the beam radius of 3.5 mm is formed after the focal spot.

2613 (IPPJ—859, pp 102-112) **Simulation code for ICF including radiative energy transfer.** Velarde, G.; Aragones, J.M.; Honrubia, J.J.; Martinez-Val, J.M.; Minguez, E.; Ocana, J.L.; Perlado, J.M. (Universidad Politecnica de Madrid (Spain)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

New improvements in the atomic physics environment of our ICF code NORMA, together with new algorithms for radiation transport are presented. Using that code, results on LHAR targets of ILE are reported and compared with ILESTA and HISHO-1D codes.

2614 (IPPJ—859, pp 113-123) **Numerical analysis of target implosion in LIB ICF.** Masubuchi, Yukio; Kawata, Shigeo. (Technological Univ. of Nagaoka, Niigata (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

The paper presents the numerical analysis for the target implosion using uniform and non-uniform beams. In the analysis we assume very simple model and use the 2-dimensional hydrodynamic code called HALLEY.

2615 (IPPJ—859, pp 124-139) **Pusherless implosion, pulse tailoring and ignition scaling law for laser fusion.** Mima, K.; Takabe, H.; Nakai, S. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

The conventional implosion scheme for high gain and high density compression depends upon piston action of an accelerated heavy pusher. However, the contact surface between the pusher and the fuel layer is very unstable in the stagnation phase. In this report, the laser pulse tailoring and the scaling laws for pellet gain, fuel rhoR and so on are discussed under the condition of very weak piston action of the pusher. The scaling laws indicate that the fuel will be ignited by 100 kJ, 0.35 μm wavelength laser irradiation.

2616 (IPPJ—859, pp 160-163) **Microinstabilities in ion beam propagation.** Okada, Toshio; Niu, Keishiro. (Tokyo Univ. of Agriculture and Technology, Koganei (Japan). Faculty of Technology). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

Microinstability for a rotating light ion beam (LIB) fusion system is investigated. Stability conditions including the effects of fractional current neutralization, rotation of LIB and beam temperature are derived for propagation through a background plasma. The results are illustrated by examining the various parameters of a rotating proton beam propagating in a plasma.

2617 (IPPJ—859, pp 164-184) **Some aspects of the unified model of non-ideal high-parameter plasmas. Electron EOS and conduction coefficients.** Drska, L.; Vondrasek, J. (Technical Univ. of Prague (Czechoslovakia)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

In the paper two partial models applied in atomic physics subpackage used in numerical simulations of pulsed-source-driven, non-ideal high-parameter plasmas are presented: electron EOS model and the model for electron conductivity coefficients calculations. The EOS model uses Dharma-Wardana exchange and correlation correction depending on both electron density and temperature. The electron thermal and electrical conductivity calculations are based on the Balescu-Lenard equation.

2618 (IPPJ—859, pp 185-192) **Stability requirement for ignition and high gain implosion. 2-D simulation for high neutron yield experiment.** Takabe, H. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

Implosion stability is the essential problem for ICF scenario, in which we expect to demonstrate the ignition by the use of 100 kJoule class driver and realize the pellet gain 100 with MJoule class driver. In order to study the stability requirement, we have developed a two dimensional fluid code, ILESTA-2D. In the present note, we report preliminary results obtained by using the 2-D code to simulate the recent high neutron yield experiment by Gekko-XII. It is found that the neutron yield is rather insensitive to the implosion with relatively smaller wavenumber nonuniformity (l = 6, 12).

2619 (IPPJ—859, pp 193-212) **Coronal fluid-dynamics in laser fusion.** Sanmartin, J.R. (Universidad Politecnica de Madrid (Spain). Escuela Tecnica Superior de Ingenieros Aeronauticos). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

The fluid-dynamics of the corona ejected by laser-fusion targets in the direct-drive approach (thermal radiation and atomic physics unimportant) is discussed. A two-fluid model involves inverse bremsstrahlung absorption, refraction, different ion and electron temperatures with energy exchange, different ion and electron velocities and magnetic field generation, and their effect on ion-electron friction and heat flux. Four dimensionless parameters determine coronal regimes for one-dimensional flows under uniform irradiation. One additional parameter is involved in two-dimensional problems, including the stability of one-dimensional flows, and the smoothing of non-uniform driving.

2620 (IPPJ—859, pp 234-249) **Finite ion-relaxation and nonequilibrium radiation effects on laser-driven implosions.** Yabe, T.; Tanaka, K.A. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

The implosion dynamics of recent experiments with high-aspect-ratio laser-driven targets are re-examined by taking account of finite mean free paths of the ion. The mean free path is found to be comparable to the fuel size and this can cause a significant departure from a fluid-like description. One of such effects stemming from the finite mean free path of the ion, real viscosity, seriously changes the results ; the compression ratio becomes 5 times smaller with this real viscosity. In addition to this, inclusion of non-LTE(local thermodynamic equilibrium) atomic process is shown to critically determine the implosion dynamics.

2621 (IPPJ—859, pp 272-289) **Two-dimensional focusing of self-magnetically insulated 'Plasma Focus Diode'.** Masugata, Katsumi; Isobe, Hironobu; Aga, Keigo; Matsumoto, Masami; Kawata, Shigeo; Yatsui, Kiyoshi. (Technological Univ. of Nagaoka, Niigata (Japan). Lab. of Beam Technology). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

A new and simple type of self-magnetically insulated vacuum ion diode named 'Plasma Focus Diode' has been successfully developed with a large solid angle of irradiation and low divergence angle. The diode has a pair of coaxial cylindrical electrodes similar to Mather type plasma focus device. Ion-current density of 1.9 kA/cm/sup 2/ has been obtained at the anode surface under the experimental conditions of diode voltage {similar←to}1.4 MV, diode current {similar←to}180 kA, and pulse width {similar←to}75 nsec. The ion beam generated has been two-dimensionally focused (line focused) with the focusing radius of {similar←to}0.18 mm, giving the maximum ion current density and beam power density at the axis to be {similar←to}130 kA/cm/sup 2/ and {similar←to}0.19 TW/cm/sup 2/, respectively. The motion of electrons in the gap has been numerically simulated by use of newly developed particle-in-cell computer simulation code, and good agreement has been obtained between the simulation and the experiment.

2622 (IPPJ—859, pp 290-300) **Research on anode plasma behavior of flashover pulsed ion sources.** Yoneda, H.; Tomita, H.; Horioka, K.; Kasuya, K. (Tokyo Inst. of Tech. (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

We measured physical parameters of anode plasma in a magnetically insulated pulsed ion diode with various diagnostic tools. The result denotes that a large amount of neutral gas particle is emitted in diode operation, and it has an important role on the determination of anode plasma characteristics and the diode performance.

2623 (IPPJ—859, pp 301-315) **Time-resolved spectroscopic measurement of anode plasma in magnetically-insulated diode.** Kawano, Yasunori; Yumino, Norihide; Araki, Yuhzo; Masugata, Katsumi; Yatsui, Kiyoshi. (Technological Univ. of Nagaoka, Niigata (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

A new diagnostic technique has been developed for the time-resolved spectroscopic measurement of anode plasma in a single-current-feed magnetically-insulated ion diode. From the measurement of Stark broadening of H/sub α/ line of hydrogen, we have estimated the electron density to be 4 {similar←to} 5 x 10/sup 16/ cm/sup -3/ using the pulse-power generator, 'ETIGO-I', typically operated with diode voltage =550 and 600 kV, diode current =36 and 53 kA, and pulse width {similar←to}90 ns (FWHM of diode current). Assuming local thermodynamic equilibrium, we have estimated the electron temperature to be 1.9 {similar←to} 2.4 eV from the measurement of light intensity ratio of successive ionization stages of carbon. The expansion velocity of the anode plasma has been found to be 4 {similar←to} 4.5 cm/μs.

2624 (IPPJ—859, pp 316-329) **Study on the flashover ion diode with cryogenic anode.** Horioka, K.; Yoneda, H.; Kasuya, K. (Tokyo Inst. of Tech. (Japan)). Feb 1988. NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW. (CONF-8709359—).

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

Our recent experimental issues to clarify the behavior of acceleration gap of flashover type magnetically insulated diodes are shown. The main issues are to investigate the cause of impurity of the extracted beam and to examine the effect of neutral particle on the impedance characteristics of the diode. A magnetically insulated diode which has a cooled anode is used for the experiments.

2625 **(IPPJ—859) Proceedings of symbosium on physics of target implosion and pulsed power techniques.** Niu, Keishiro (ed.). (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1988. Vp. (CONF-8709359—). NTIS (US Sales Only), PC A15/MF A01. Order Number DE89780016/JAW.

From Symposium on physics of target implosion and pulsed power techniques; Yokohama, Japan (30 Sep 1987).

This meeting deals with techniques used to create target implosion in fusion reactors. The individual papers have been abstracted and indexed.

2626 **(JAERI-M—88-062) Japanese contributions to IAEA INTOR Workshop, Phase Two A, Part 3. Chapter XI: system analysis of INTOR-like designs.** Mizoguchi, Tadanori; Iida, Hiromasa; Sugihara, Masayoshi and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 81p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755209/JAW.

This report corresponds to Chapter XI of Japanese contribution report to IAEA workshop, Phase Two A, Part 3. The purpose of this system analysis is to clarify the reason why the INTOR-like designs of each delegation differ from each other. Benchmark studies of INTOR (IAEA), FER (Japan), NET (EC), TIBER (USA) and OTR (USSR) are carried out by the conceptual design system code (TRESCODE). As results of the global sensitivity analysis, it is found that the choices of design features/drivers give the largest impact on the reactor size and capital cost. There is smooth correlation between plasma major radius and capital cost. Individual sensitivity analysis reveals that additional ignition margin, higher Z/ sub eff/, higher toroidal field coil design and change of operation scenario (hybrid to full inductive) result in an increase of reactor size and cost.

2627 **(JAERI-M—88-063) Review of JT-60 experimental results from June to October, 1987.** (Japan Atomic Energy Research Inst., Tokyo). Mar 1988. 492p. (In Japanese). NTIS (US Sales Only), PC A21/MF A01. Order Number DE88755210/JAW.

This is a prompt report on JT-60 experimental results from June to October, 1987. Experiments in hydrogen plasmas have been undertaken with up to 3.2 MA of plasma current in limiter discharges, 2.7 MA in divertor discharges, and 30 MW of total NB (H/sup 0/ -> H/sup +/) and RF injection power. In limiter discharges with {similar←to}3 MA plasma current, the maximum central electron density of 1.3 x 10/sup 20/ m/sup -3/ and the energy confinement time of 0.15 - 0.18 sec were obtained with heating powers of 13 - 20 MW. The total plasma stored energy of 3.1 MJ, and n/sub e/(0)tau/sub E/ of 1.4 - 1.8 x 10/sup 19/ m/sup -3/ sec were achieved. The best set of parameters achieved is n/sub e/(0)tau/sub E/ = 1.8 x 10/sup 19/ m/sup -3/ sec and T/sub i/(0) = 3.7 KeV at plasma current of 3.2 MA. By applying deutrium discharge condition, n/sub e/(0)tau/sub E/ and T/sub i/(0) enter the JT-60 target area determined by Atomic Energy Commission. Many short periods (50 - 100 ms) of H-mode phase are found in outside X-point divertor discharges with NB or NB + RF (LH or IC) heating power of more than 16 MW, although at present the energy confinement improvement is limited to within 10 %. In combined LH and NB heating of low-n-bar/sub e/ discharge, the plasma stored energy increases with the same rate as NB heating only, with preferential absorption of LH wave to the high energy beam ions. In combined NB and on-axis ICRF heating of low-n-bar/sub e/ discharge, a high incremental energy confinement time is obtained, with strong high energy beam ion acceleration and electron heating in the central region of the plasma.

2628 **(JAERI-M—88-088) Low energy, high power injection in JT-60 NBI.** Mizuno, Makoto; Dairaku, Masayuki; Horiike, Hiroshi and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). May 1988. 17p. (In Japanese). NTIS (US Sales Only), PC A03/ MF A01. Order Number DE88755211/JAW.

JT-60 neutral beam injector (JT-60 NBI) is designed to inject 20 MW neutral hydrogen beam at energies of 70 {similar←to} 100 keV and the injection power decreases significantly at low energies ({similar←to}40 keV). For the extention of operation region aiming at the low density plasma heating and achieving H-mode by plasma periphery heating, increment of the injection power at low beam energies was required. The single-stage acceleration system was investigated in advance at the Prototype Injector Unit. From this result, the total injection power of 17 MW at 40 keV, 48 A per source was expected at the JT-60 NBI. This system was adopted in the JT-60 NBI from June, 1987 to July, 1987 and 17.6 MW neutral beam injection power was achieved. In the NB heating experiment, the H-mode transition phenomena was observed in JT-60 plasma.

2629 **(JAERI-M—88-123) Present status of JT-60 ICRF heating experiment.** Kimura, Haruyuki; Fujii, Tsuneyuki; Saigusa, Mikio and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jul 1988. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755223/JAW.

Recent results on JT-60 ion-cyclotron-range-of-frequency (ICRF) heating experiment in the second harmonic regime are reviewed. Remarkable beam acceleration by second harmonic ICRF wave was observed during combined heating with neutral-beam-injection (NBI). Incremental energy confinement time of ICRF up to 210 msec was obtained with beam acceleration, which is about three times as high as that of NBI or ICRF heating alone case. Second harmonic ICRF heating is also effective in ohmic target plasma with antenna phasing in the toroidal direction. Antenna coupling properties during H-mode were investigated. Coupling resistance increased after H-transition in (π,0) mode. Future plan for upgrade of the JT-60 ICRF heating system is also presented.

2630 **(KMSF-U—2048) The role of sandwich holography in ICF [Inertial Confinement Fusion].** Pattinson, T.R.; Musinski, D.L.; Felmlee, W.J. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1988. Contract AC03-87DP10560. 8p. (CONF-881002—15). NTIS, PC A02/MF A01. Order Number DE89001441/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

We demonstrate that holographic interferometry is applicable for documenting cryogenic fuel layers in several experimental systems. Sandwich holography as designed for our β-heating system can be readily adapted for use on larger, more complex systems by proper selection of short pulse lengths and high intensities for exposing the film. Reconstruction of the holographic pair requires only a simple laser and a micropositioner. It is our belief that sandwich holography holds high potential for documenting condensed fuel layers in several areas of the national ICF program. 4 figs.

2631 **(KMSF-U—2049) Methods for utilizing beta-decay driven DT fuel layers in inertial confinement fusion experiments.** Mruzek, M.T.; Musinski, D.L. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1988. Contract AC03-87DP10560. 13p. (CONF-881002—17). NTIS, PC A03/MF A01. Order Number DE89001430/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

The beta-decay driven redistribution of solid deuterium-tritium (DT) fuel in Inertial Confinement Fusion (ICF) targets has recently emerged as a promising technique for fabricating cryogenic targets with uniform fuel layers. Beta decay driven solid layers may be useful as more energetic driver systems are built and operated. Systems such as the Particle Beam fusion Accelerator (PBFA) at

Sandia National Laboratory and the proposed Laboratory Microfusion Facility (LMF) will be conducting implosion experiments within the next ten years. Beta-decay driven fuel layers can conceivably solve many of the current problems with cryogenic targets in the ICF community, although the same technology also introduces several new experimental constraints. We review the process of Beta decay fuel redistribution. Next, we highlight the major differences between current target technology and the utilization of the new technique. Finally, we comment on experimental hardware configurations which appear promising for incorporation into laboratory scale microfusion experiments. 8 refs., 3 figs.

2632 **(KMSF-U—2104) Geometric characterization of macroshell targets.** Alway, P.C.; Scott, L.A.; Martin, A.J. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1988. Contract AC03-87DP10560. 12p. (CONF-881002—18). NTIS, PC A03/MF A01. Order Number DE89001431/JAW.

From 35. national vacuum symposium and 4th international laser science conference; Atlanta, GA, USA (2 Oct 1988).

We are investigating methods of fabricating and characterizing large diameter, thin-walled glass capsules for Inertial Fusion (IF) experiments. Dimensional requirements for the capsules specify diameters of two to ten millimeters and a wide range of aspect ratios (diameter/wall). These shells are larger in diameter than shells made in drop towers. Because of their larger size, they have been given the designation, macroshell. Glass macroshell targets are transparent, seamless, fuel containers which are currently used in beta-heating experiments at KMSF. The capsules are also potentially useful for neutron production experiments with IF drivers like Nova. The technology developed to fabricate these fuel containers may be useful in the fabrication of polymer shells necessary for the proposed Laboratory Microfusion Facility (LMF); some work with polymers has started. Accurate target characterization is essential to ensure the accurate measurement of fuel layers produced by radioactively induced sublimation of cyrogenically cooled deuterium-tritium (DT) fuel. 3 refs., 4 figs.

2633 **(LA-UR—88-3304) Experimental studies of x-ray emission physics and hydrodynamics using short wavelength lasers.** Goldstone, P.D.; Casperson, D.E.; Cobble, J.A.; Coggeshall, S.V.; Gomez, C.C.; Hauer, A.; Kyrala, G.A.; Lee, P.H.Y.; Mead, W.C.; Schappert, G.T. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 17p. (CONF-881056—3). NTIS, PC A03/MF A01. Order Number DE89002053/JAW.

From 19. European conference on laser interaction with matter (ECLIM); Madrid, Spain (3 Oct 1988).

Several experimental efforts are currently under way at Low Alamos to study issues of importance for inertial confinement fusion with short wavelength lasers. These issues include the physics of x-ray conversion and the dynamics of short-wavelength laser interaction with high-Z plasmas; filamentation and self-focusing processes; and the growth of instabilities in laser-driven implosions. Most of these experiments are being pursued in collaboration with other laboratories, notably the University of Rochester and Lawrence Livermore National Laboratory. In addition, we are undertaking basic studies of the interaction of both atomic systems and solids with ultra-intense ({approximately}10^{17} W/cm^2) subpicosecond lasers at Los Alamos. These experiments explore the response of atomic systems to strong fields, multiphoton excitation, and transient phenomena in dense plasmas. 15 refs., 3 figs.

2634 **(NIIEFA-P-B—0770) Numerical simulation of axial-symmetrical quasistationary electromagnetic fields on the base of net technique.** Lamzin, E.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704670/JAW.

Axial-symmetric quasistationary electrodynamics problem setting under the absence of free volumetric charges is considered. Algorithm of calculating vortex current electromagnetic field using a computer with regard to current-carrying element heating process is developed on the basis of finite-difference approach. Evaluation of pulsed toroidal magnetic field corrugation for "Tuman-3" tokamak is conducted. 12 refs.; 4 figs.

2635 **(ORNL/FEDC—88/2) Trade studies of plasma elongation for next-step tokamaks.** Galambos, J.D.; Strickler, D.J.; Peng, Y.K.M.; Reid, R.L. (Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center). Sep 1988. Contract AC05-84OR21400. 36p. NTIS, PC A03/MF A01. Order Number DE89001950/JAW.

The effect of elongation on minimum-cost devices is investigated for elongations ranging from 2 to 3. The analysis, carried out with the TETRA tokamak systems code, includes the effects of elongation on both physics (plasma beta limit) and engineering (poloidal field coil currents) issues. When ignition is required, the minimum cost occurs for elongations from 2.3 to 2.9, depending on the plasma energy confinement scaling used. Scalings that include favorable plasma current dependence and/or degradation with fusion power tend to have minimum cost at higher elongation (2.5-2.9); scalings that depend primarily on size result in lower elongation ({approximately}2.3) for minimum cost. For design concepts that include steady-state current-driven operation, minimum cost occurs at an elongation of 2.3. 12 refs., 13 figs.

2636 **(ORNL/TM—10833) Design considerations for single-stage and two-stage pneumatic pellet injectors.** Gouge, M.J.; Combs, S.K.; Fisher, P.W.; Milora, S.L. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01. Order Number DE89001957/JAW.

Performance of single-stage pneumatic pellet injectors is compared with several models for one-dimensional, compressible fluid flow. Agreement is quite good for models that reflect actual breech chamber geometry and incorporate nonideal effects such as gas friction. Several methods of improving the performance of single-stage pneumatic pellet injectors in the near term are outlined. The design and performance of two-stage pneumatic pellet injectors are discussed, and initial data from the two-stage pneumatic pellet injector test facility at Oak Ridge National Laboratory are presented. Finally, a concept for a repeating two-stage pneumatic pellet injector is described. 27 refs., 8 figs., 3 tabs.

2637 **(Rijnhuizen—85-161) Development of a magneto-optic current-measurement system for high, pulsed currents.** Lassing, H.S. (Associatie Euratom-FOM, Nieuwegein (Netherlands). FOM-Instituut voor Plasmafysica). Dec 1985. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88780123/JAW.

A current-measurement system based on the Faraday rotation in a single-mode fiber is described. It is shown that an ultra low birefringence "spun" single-mode fiber is extremely suitable for use in a magneto-optic current-meter. The properties of this fiber have been investigated. Measurements of high, pulsed currents with good accuracy and in accord with theory are presented. In order to calculate the current unambiguously and more accurate from the signals of the current-meter, a system with a double detector was constructed. Measurements of high, pulsed currents with this system are also presented. 34 figs., 12 refs., 3 tabs.

2638 **(RISO-M—2730) Methods used for the estimation of gamma doses in and around a tokamak reactor.** Hoejerup, C.F. (Risoe National Lab., Roskilde (Denmark)). Jul 1988. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755130/JAW.

Monte Carlo calculations of neutron flux in the NET reactor are described. The gamma sources from neutron capture reactions and from decays of radioactive nuclides are determined. A "reciprocity" approach is described, which in an approximate way, but with a reasonable calculational effort, allows an estimation of the gamma dose in selected points from all the distributed sources.

2639 **(SAND—87-2993C) Investigations of magnetically insulated electron flows.** Mendel, C.W. Jr.; Quintenz, J.P.; Rosenthal, S.E.; Seidel, D.B.; Desjarlais, M.P.; Coats, R.; Savage, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880713—18). NTIS, PC A02/MF A01. Order Number DE89001670/JAW.

From Beams '88: 7th international conference on high-power particle beams; Karlsruhe, F.R. Germany (4 Jul 1988).

Magnetic insulation of electron flow has become very important in super-power pulsers used with X-ray sources, inertially confined fusion experiments, etc. This paper will describe several recent experiments on these flows, and compare the results to advances in theoretical understanding. The experiments include flows in pitched magnetic fields like those found in magnetically insulated ion diodes, some initial experiments on the internal structure of the flows, and measurements on the loss of insulation at magnetic nulls (sometimes called zingers). Some surprising results on recapture of large electron currents will be presented. These results are not yet fully understood, but have encouraging implications for pulsed power devices such as ion diodes. 11 refs., 7 figs.

2640 **(SAND—88-2860C) Beams 1988 panel presentation.** VanDevender, P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880713—17). NTIS, PC A02/MF A01. Order Number DE89001445/JAW.

From Beams '88: 7th international conference on high-power particle beams; Karlsruhe, F.R. Germany (4 Jul 1988).

This paper discusses the operation of the Particle Beam Fusion Accelerator. Component development and beam diagnostic techniques are briefly reviewed. (LSP)

2641 **(SLAC-PUB—4699) Progress in Heavy Ion Fusion.** Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 4p. (CONF-880967—5). NTIS, PC A02/MF A01. Order Number DE89002072/JAW.

From Fusion Power Associates annual meeting and symposium on the creation of compact, high power density plasmas; Santa Fe, NM, USA (6 Sep 1988).

The progress of the field of Heavy Ion Fusion has been documented in the proceedings of the series of International Symposia that, in recent years, have occurred every second year. The latest of these conferences was hosted by Gesellshaft fuer Schwerionenforshung (GSI) in Darmstadt, West Germany, June 28-30, 1988. For this report, a few highlights from the conference are selected, stressing experimental progress and prospects for future advances. A little extra time is devoted to report on the developments at the Lawrence Berkeley Laboratory (LBL) which is the center for most of the HIFAR program. The Director of the HIFAR program at LBL is Denis Keefe, who presented the HIF report at the last two of the meetings in this series, and in whose place the author is appearing now. 4 refs., 1 fig.

2642 **(SLAC-PUB—4718) Induction linac drivers for heavy ion fusion.** Herrmannsfeldt, W.B.; Keefe, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1988. Contract AC03-76SF00515. 5p. (LBL—26031; CONF-881056—2). NTIS, PC A02/MF A01. Order Number DE89002391/JAW.

From 19. European conference on laser interaction with matter (ECLIM); Madrid, Spain (3 Oct 1988).

The Heavy Ion Fusion Accelerator Research (HIFAR) program of the USDOE has for several years concentrated on developing linear induction accelerators as Inertial Fusion (IF) drivers. This accelerator technology is suitable for the IF application because it is readily capable of accelerating short, intense pulses of charged particles with good electrical efficiency. The principal technical difficulty is in injecting and transporting the intense pulses while maintaining the necessary beam quality. The approach used has been to design a system of multiple beams so that not all of the charge has to be confined in a single beam line. The beams are finally brought together in a common focus at the target. This paper will briefly present the status and future plans of the program, and will also briefly review systems study results for HIF. 2 refs., 5 figs.

2643 **(UCID—21435) Fabrication and operation of a system for the PVA [polyvinyl alcohol] coating of polymer microshells with trace gas fill.** King, K.J. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1988. Contract W-7405-ENG-48. 17p. NTIS, PC A03/MF A01. Order Number DE89001467/JAW.

Polymer microshells with a PVA (polyvinyl alcohol) coating are produced for the ICF Program by the Fusion Target Fabrication (FTF) Group at Lawrence Livermore National Laboratories. A PVA coating greatly reduces the permeation of gas through a polymer microshell. The equipment and procedures used in the production of PVA coated microshells are discussed. 6 figs.

2644 **(UCID—21514) A computational analysis of a compact toroid x-ray source.** Gee, M.; Hammer, J.H.; Nowak, P.F.; Hartman, C.W.; Zimmerman, G.B. (Lawrence Livermore National Lab., CA (USA)). 15 Sep 1988. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01. Order Number DE89001900/JAW.

This is a preliminary report which discusses the computational analysis of a compact toroid x-ray source. X-ray sources are often used to test the "hardness" of electronics and structures to harsh radiation environments. A compact torus x-ray source may be useful for this task because it appears that a high power x-ray source could be produced easily and at a fraction of the cost of x-ray sources currently used for radiation hardness experiments. In addition, by varying the elemental composition of the plasma, the x-ray spectrum can be tailored for a variety of applications. The procedure for generating x-rays consists of accelerating a magnetically confined plasma ring and stagnating it against a stationary object, such as a metal plate. This rapid interaction heats the plasma, via a hydrodynamic shock, and subsequent bound-bound transitions and electron bremsstrahlung generate radiation in the form of x-rays, if the temperature is sufficiently high. We begin with a description of the compact torus and review an experiment which demonstrated the feasibility of the concept. Subsequently, we present the methodology used to simulate the physical behavior of the compact torus as it shock heats. Some details of the initial conditions, physical models and assumptions used for these calculations are discussed. The results of the numerical calculations are reviewed with particular attention given to the x-ray spectrum that is produced and how it may be used as a practical source. Finally, we discuss the uncertainties present in the calculations and how they may be reduced by more detailed modeling. 4 refs., 3 figs.

2645 **(UCRL—98469) Rotating liquid blanket with no first wall for fusion reactors.** Moir, R.W. (Lawrence Livermore National Lab., CA (USA)). 5 Oct 1988. Contract W-7405-ENG-48. 6p. (CONF-881031—23). NTIS, PC A02/MF A01. Order Number DE89001722/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

A toroidal vortex of liquid FLiBe (LiF + BeF_2) is suggested for the blanket of a fusion reactor. Because this system has no solid first wall, it might avoid many of the problems that accompany conventional blanket design. The liquid is sustained by nozzles that inject a continuous layer of cool liquid on the inner surface. A second set of nozzles sends a stream of droplets across the diverted scrape-off layer or edge plasma to carry its heat away. The feasibility issues of most importance are judged to be avoiding turbulent breakup of the vortex and preventing too much contamination of the plasma by the evaporating FLiBe. 6 refs., 5 figs., 1 tab.

2646 **(UCRL—98728) Magnet systems for the International Thermonuclear Experimental Reactor.** Henning, C.D.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 22 Sep 1988. Contract W-7405-ENG-48. 5p. (CONF-880812—19). NTIS, PC A02/MF A01. Order Number DE89001725/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

The definition phase for the International Thermonuclear Experimental Reactor (ITER) has been nearly completed, thus beginning a three-year design effort by teams from the European Community (EC), Japan, US, and USSR. Preliminary parameters for the superconducting magnet system have been established to guide more detailed design work. Radiation tolerance of the superconductors and insulators has been important because it sets requirements for the neutron-shield dimension and sensitively influences reactor size. Major levels of mechanical stress appear in the structural cases of the inboard legs of the toroidal-field (TF) coils. The winding packs of the TF coils include significant fractions of

steel that provide support against in-plane separating loads, but they offer little support against out-of-plane loads unless shear-bonding of the conductors can be maintained. Heat removal from nuclear and ac loads has not limited the fundamental design, but it has non-negligible economic consequences. 3 refs., 3 figs., 5 tabs.

2647 **(UCRL—99472) Structural characteristics of proposed ITER [International Thermonuclear Experimental Reactor] TF [toroidal field] coil conductor.** Gibson, C.R.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 19 Aug 1988. Contract W-7405-ENG-48. 6p. (CONF-880812—17). NTIS, PC A02/MF A01. Order Number DE89001496/JAW.

From Applied superconductivity conference; San Francisco, CA, USA (21 Aug 1988).

This paper analyzes the effect of transverse loading on a cable-in-conduit conductor which has been proposed for the toroidal field coils of the International Thermonuclear Experimental Reactor. The primary components of this conductor are a loose cable of superconducting wires, a thin-wall tube for helium containment, and a U-shaped structural channel. A method is given where the geometry of this conductor can be optimized for a given set of operating conditions. It is shown, using finite-element modeling, that the structural channel is effective in supporting loads due to transverse forces and internal pressure. In addition, it is shown that the superconducting cable is effectively shielded from external transverse loads that might otherwise degrade its current carrying capacity. 10 refs., 10 figs., 3 tabs.

2648 **(WHC-SA—0328) IFMIF [International Fusion Materials Irradiation Facility], an accelerator-based neutron source for fusion components irradiation testing: Materials testing capabilities.** Mann, F.M. (Westinghouse Hanford Co., Richland, WA (USA)). Aug 1988. Contract AC06-87RL10930. 4p. (CONF-881031—24). NTIS, PC A02/MF A01. Order Number DE89001919/JAW.

From 8. topical meeting on technology of fusion energy; Salt Lake City, UT, USA (9 Oct 1988).

The International Fusion Materials Irradiation Facility (IFMIF) is proposed as an advanced accelerator-based neutron source for high-flux irradiation testing of large-sized fusion reactor components. The facility would require only small extensions to existing accelerator and target technology originally developed for the Fusion Materials Irradiation Test (FMIT) facility. At the extended facility, neutrons would be produced by a 0.1-A beam of 35-MeV deuterons incident upon a liquid lithium target. The volume available for high-flux (>10{sup 15} n/cm{sup 2}-s) testing in IFMITF would be over a liter, a factor of about three larger than in the FMIT facility. This is because the effective beam current of 35-MeV deuterons on target can be increased by a factor of ten to 1A or more. Such an increase can be accomplished by funneling beams of deuterium ions from the radio-frequency quadruple into a linear accelerator and by taking advantage of recent developments in accelerator technology. Multiple beams and large total current allow great variety in available testing. For example, multiple simultaneous experiments, and great flexibility in tailoring spatial distributions of flux and spectra can be achieved. 5 refs., 2 figs., 1 tab.

2649 **Two-pulse injector experiments with the RIIM electron accelerator.** Mazarakis, M.G.; Smith, D.L.; Jones, E.E.; Hasti, D.E.; Jojola, J.M.; Lehmann, M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **64**: No. 10, 4815-4819(15 Nov 1988).

The RADLAC-II accelerator foilless diode injector was operated under double-pulse conditions utilizing the RIIM accelerator as the test bed [M. G. Mazarakis, D. L. Smith, R. B. Miller, R. S. Clark, D. E. Hasti, D. L. Johnson, J. W. Poukey, K. R. Prestwich, and S. L. Shope, IEEE Trans. Nucl. Sci. NS-32, 3237 (1985)]. The original RIIM accelerator pulsed-power network was modified to provide for the generation, transmission, and delivery to the foilless diode of two distinct multimegavolt pulses with variable interpulse separation from 0 to 2 ms. The foilless diode successfully produced two 10-kA current pulses with interpulse separations up to 1 μs. For larger separations, the generated plasma and an excessive neutral gas release following the first pulse prevented the diode from producing a second current pulse.

2650 **Development testing of the U.S. common long pulse source at 120 kV.** Vella, M.C.; Cooper, W.S.; Pincosy, P.A.; Pyle, R.V.; Weber, P.D.; Wells, R.P. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Review of Scientific Instruments;* **59**: No. 11, 2357-2365(Nov 1988).

The U. S. magnetic fusion energy program has developed a single design, long-pulse neutral beam source for TFTR, MFTF-B, and DIII-D. The arc is a very compact axial magnetic line cusp. The accelerator is an actively cooled tetrode with water-cooled grid tubes of shaped molybdenum forming "slot" beamlets. DIII-D and MFTF-B configurations have an 80-kV accelerator gap, with a 12 x 18 cm aperture, and a 10-m "module" focus. TFTR modules are unfocused, with a 120-kV gap and 12 x 43-cm mask. The first CLPS was tested in the TFTR configuration, at 120 kV, 2s. Optimum current was 73 A, or 1.76 μpervs (deuterium), with 80%—85% atomic fraction. Optimum divergence of ions plus neutrals was 0.4° parallel to the slots, and 0.7° perpendicular to the slots (1/e half-angle). The combination of an axial cusp magnetic bucket and slot accelerator apertures gives the common long pulse source about twice the beam power per unit cross section of other long pulse sources, plus lower divergence in the direction parallel to the slots.

2651 **Current clamping in a long pulse electron beam-gas interaction.** Bosch, R.A.; Bidwell, S.W.; Gilgenbach, R.M. (Intense Energy Beam Interaction Lab., Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **16**: No. 4, 428-432(Aug 1988).

Current clamping (constant current behavior) was observed in measurements of the current drawn by a metal plate that acts as a beam collector for a long pulse (300 ns) electron beam propagating a short distance through low pressure gas (40-1000 mtorr). When the clamping occurs, oscillations in the beam collector current are reduced, resulting in a flat current pulse. Good agreement is found with a model which considers the impedance of the plasma produced by the electron beam in parallel with the inductance of the beam collector current path. The current clamping occurs when the plasma impedance is smaller than the inductive impedance of the beam collector current path.

2652 **Heat transfer for fusion component applications.** Boyd, R.D. (Prairie View A and M Univ., Dept. of Mechanical Engineering, P.O. Drawer "G", Prairie, TX (US)). *Fusion Technology;* **13**: No. 4, 644-653(May 1988).

A quasi-automated high heat flux flow boiling facility has been developed for the systematic study of critical heat flux (CHF), heat transfer, and two-phase pressure drop. High heat flux research is important in state-of-the-art electronics and fusion component design. For fusion applications, there are practically no low-pressure data for large values of coolant channel length-to-diameter (L/D) ratio (i.e., 100), channel diameters near 1.0 cm, and medium to high heat flux levels (i.e., 100 to 2000 W/cm/sup 2/). A second step is provided to fill this void. Forced flow boiling (with water) quasi-steady experiments have been conducted on uniformly (resistively) heated horizontal copper tubes. The tubes were 1.02 cm in inside diameter and 117.87 cm long. The inlet water temperature was 20°C. For a 1.6-MPa exit pressure, measurements of the CHF varied from the annular flow regime (150 W/cm/sup 2/) to the subcooled flow boiling water regime (425 W/cm/sup 2/). The mass velocity was varied form 0.63 to 3.5 Mg/m/sup 2/ . s. At 1.6 MPa, the transition between the annular and subcooled CHF regimes were measured to occur between 1.03 and 1.26 Mg/m/sup 2/ . s. Large axial variations in the Nusselt number were also measured.

2653 **Transport simulation of a field-reversed configuration plasma.** Shumaker, D.E. (Lawrence Livermore National Lab., National Magnetic Fusion Energy Computer Center, Livermore, CA (US)). *Fusion Technology;* **13**: No. 4, 555-576(May 1988).

A numerical simulation of the evaluation of a field-reversed configuration (FRC) plasma is described. The calculation proceeds by alternating between a two-dimensional axisymmetric equilibrium calculation and a one-dimensional transport calculation. The equi-

librium calculation uses flux-surface coordinates and finite elements. The transport calculation consists of the simultaneous solution of the three one-dimensional equations for the differential ion density, electron entropy, and ion entropy. The transport calculation includes classical transport processes, loss on open field lines, radiation cooling due to impurities, and lower hybrid drift anomalous transport. Examples of FRC simulations are presented.

2654 **Plasma transport in a Compact Ignition Tokamak.** Singer, C.E.; Ku, L.P.; Bateman, G. (Dept. of Nuclear Engineering, 214 Nuclear Engineering Lab., 103 South Goodwin, Urbana, IL (US)). *Fusion Technology;* **13**: No. 4, 543-554(May 1988).

Nominal predicted plasma conditions in a Compact Ignition Tokamak (CIT) are illustrated by transport simulations using experimentally calibrated plasma transport models. The range of uncertainty in these predictions is explored by using various models that have given almost equally good fits to experimental data. Using a transport model that best fits the data, thermonuclear ignition occurs in a CIT design with a major radius of 1.32 m, plasma half-width of 0.43 mn, elongation of 2.0, and toroidal field and plasma current ramped in 6 s from 1.7 to 10.4 T and 0.7 to 10 MA, respectively. Ignition is facilitated by 20 MW of heating deposited off the magnetic axis near the /sup 3/He minority cyclotron resonance layer. Under these conditions, sawtooth oscillations are small and have little impact on ignition. Tritium inventory is minimized by preconditioning most discharges with deuterium. Tritium is injected, in large frozen pellets, only after minority resonance preheating. Variations of the transport model, impurity influx, heating profile, and pellet ablation rates have a large effect on ignition and on the maximum beta that can be achieved.

2655 **Radiological dose calculations for the diode region of the Light Ion Fusion Target Development Facility.** Henderson, D.L.; Sawan, M.E.; Moses, G.A. (Oak Ridge National Lab., Oak Ridge, TN (US)). *Fusion Technology;* **13**: No. 4, 594-615(May 1988).

Biological dose rate calculations have been performed for a point external to the diode vacuum casing of the proposed Light Ion Fusion Target Development Facility for times following an operational period of 1 month. The primary diode material considered is Type 304LN stainless steel, with an alternative material of Al-6061-T6. Using a realistic pulse-sequence calculation scheme to account for the pulsed operation mode of the facility, it is shown that for both the stainless steel and aluminum diodes the dose rates external to the diode vacuum casing are >1 rem/h after a 1-day shutdown period. After a 1-week shutdown period, the dose rates have dropped to 90 and 12 mrem/h, respectively.

99 GENERAL AND MISCELLANEOUS

REFER ALSO TO CITATION(S) 705, 2417, 2418

2656 **(INIS-mf—11802) List of scientific and technological reports of the Nuclear Research Center Juelich Jan. 1985 - March 1988. 2. ed.** (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralbibliothek). 1988. 68p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88755167/JAW.

This list of scientific and technological reports at first comprises some general publications such as abbreviations used in technical reports, annual report for 1984, 1985, 1986, the list of reports 1984 and 1985, surveys and inquiries on the population to the Chernobyl accident and on the scientific personnel of Juelich to the transfer of scientific knowledge to the public. - The other reports are concerned with the subjects mathematics - computer - cybernetics, general physics, atomic- and nuclear physics, solid state physics, materials, analytical chemistry, technology, reactor techniques, measuring techniques, biology, agriculture, questions of energy, medicine, environment, plasma physics and fusion reactor technology, physical chemistry, nuclear- and radiochemistry, chemical technology, electrotechniques - electronics, geosciences. Finally a register of the authors is added.

2657 **(LA—11400-MS) Publications of Los Alamos research, 1987.** Varjabedian, K.; McClary, W.J.; Rich, J.A.; Dussart, S.A. (comps.). (Los Alamos National Lab., NM (USA)). Sep 1988. Contract W-7405-ENG-36. 200p. NTIS, PC A09/MF A01. Order Number DE89002093/JAW.

This bibliography lists unclassified publications of work done at the Los Alamos National Laboratory for 1987. The entries, which are subdivided by broad subject categories, are cross-referenced with an author index and a numeric index.

2658 (ORAU—88/A-73, pp 7-14) **On-the-job training at Savannah River Plant.** James, J.D. (E. I. DuPont de Nemours & Co., Aiken, SC (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

The author is responsible for the quality of training within the Separations Department at the Savannah River Plant - that it maintain the high standard of Dupont Training and satisfy DOE requirements. He contrasts present on-the-job training activities after implementation of the New Separations Department Training Program in March 1985 with former training. His concept is that, presently, on-the-job training implies acquisition of job skills regardless of the setting or location of the training - as contrasted with the narrow definition of training conducted at the job site. He emphasizes that the Learning Triangle - with Knowledge, Skills, and Attitudes each forming sides of the Triangle - must be successfully completed to have a productive employee. 8 figures.

2659 (ORAU—88/A-73, pp 15-17) **Pre-employment job orientation seminar - after two years.** Petullo, C.F. (Reynolds Electric and Engineering Co., Inc., Las Vegas, NV (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

Formerly, applicants for the Radiation Monitor job were primarily individuals with 4-yr degrees in the sciences or engineering, because of upgraded education requirements. Reynolds found, however, that they lost a very high percentage of such hirees within 4 months after training and going into the field - since they had felt they were hired for a white collar job. Therefore, they instituted the Pre-Employment Job Training Seminar for all applicants - a 40-minute slide presentation showing the Nevada Test Site Terrain; Radiation Monitor job locations such as tunnels, drill rigs, and a decontamination facility; and Radiation Monitors active in their job functions. In other words the earthy side of the job is depicted. Applicants still interested in the job after initial orientation stay for a 3-hour examination. The author expects future hiring at the technician level, with job requirements a high school diploma and science and math skills necessary for good job performance.

2660 (ORAU—88/A-73, pp 19-29) **Trainer certification.** Couser, S.; Moore, J. (Martin Marietta Energy Systems, Inc., Piketon, OH (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

A DOE Technical Safety Appraisal in October 1986 found that training at the Portsmouth Gaseous Diffusion Plant was fragmented and lacked uniformity. Training was localized in departments and was more often handled by line supervisors, etc. - with no certification. The Trainer Certification Program has provided the means for applying standard guidelines to ensure that training is designed, applied, and evaluated in a consistent, effective, and efficient manner. The program is in a state of substantial change and a target date for compliance is set for 1989. Trainer certification will provide both current and future resources to ensure consistent and effective training. 22 figures.

2661 (ORAU—88/A-73, pp 31-36) **Orienting the professional.** Westlund, C. (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

No matter how accomplished and competent professionals are in their fields, it may take a long time after employment for them to become organizationally effective. For this and other reasons, management developed a training program designed to orient staff engineers at Hanford. The task was designated as an award-free item, which added an incentive to meet the challenge, and the scope was developed to include both the Radiological Engineer and the Quality Engineer. The training program was designed to establish and maintain the credibility of the professional, to provide consistency in the manner of doing business, and to reverse a trend of high turnover within several disciplines. So far results are positive, and is improving the time required for the professional engineer to become organizationally effective. 6 figures.

2662 (ORAU—88/A-73, pp 37-40) **Maintaining technical training instructor competence: a DOE contractor survey.** Smith, A.C. (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

A telephone survey of 13 DOE contractors was conducted to support the TRADE Technical Training Workshop on Maintaining Instructor Competence. The purpose of the survey was to determine how many contractors had implemented a formal program to maintain the technical and/or instructional competence of their training instructors. The survey also included questions designed to provide insight and background information about the contractor training organizations and training programs. This telephone survey consisted of eight questions which are identified, along with the responses given.

2663 (ORAU—88/A-73, pp 41-48) **Maintaining instructor technical competency at WINCO.** Rockwell, N.C. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

At WINCO, 5 managers and 27 instructors provide technical training in four main areas: Operations, Maintenance, Radiological and Nuclear Safety, and Pilot Plant Operations and Industrial Safety. Mr. Rockwell first describes requirements and practices that pertain to the entire training organization; then discusses specific practices that help maintain the technical knowledge and skills of the instructors in the four main areas, above. He emphasizes it is much easier to maintain a high level of instructor competency if you start at a high level. Over 75% of WINCO's instructors were subject matter experts in the referent organizations before coming to training.

2664 (ORAU—88/A-73, pp 49-56) **Maintenance training - who needs it?.** Adams, H. (Rockwell International, Golden, CO (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

The author's job responsibilities at Rocky Flats include preventive maintenance, training to meet the needs of maintenance personnel, training for special projects such as welding and metal fabrication, and reporting to the manager of plant maintenance engineers. He notes that many old-line manufacturers are becoming high-tech companies, emphasizing the role of automation in production and quality control. He lists and discusses changes at Rocky Flats, along with the attendant preventive maintenance program the changes necessitate. He observes estimates that training costs to companies over the next 10 years will exceed 10% of their revenues - that in 1986, American companies spent $210 billion on training at all levels. But, if you think training is expensive, try placing a cost on ignorance. 9 figures.

2665 (ORAU—88/A-73, pp 57-62) **Factors that contribute to an effective maintenance program.** Daily, B. (Dept. of Energy, Washington, DC (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

Noting that DOE is a very large land and property owner, Mr. Daily first examines the DOE Maintenance Management Program and the DOE Order establishing policy. Essentially, each DOE field organization (both government and contractor operated) must establish specific, formal programs for efficiently and effectively maintaining, repairing, and improving the Departments' real property. The sizable and varied tasks involved create many challenges and opportunities for those guiding DOE's training programs. Mr. Daily divides training into two categories: (1) broad and general craft, which might be an apprentice program; and (2) more detailed training for specific and difficult tasks, which might include electronic-controls trouble shooting and repair. He is particularly concerned about the apprentice program at DOE and the apparent trends to eliminate it, in response to budget economies. He feels this is shortsighted, and management should reverse this as soon as possible.

2666 (ORAU—88/A-73, pp 63-64) **Maintenance training documentation.** Rockwell, N.C. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

The following are used to document training at WINCO: class attendance sheets, lesson plans, examinations, qualification standards, progression guides, and promotion papers. The Training Section has implemented a numbering system that identifies each of the various documents. This system is used to track all training documents. Contents of the Maintenance Training File and the Safety Training File are listed.

2667 (ORAU—88/A-73, pp 95-110) **Accreditation - making and meeting your own standards.** Birk, S.M. (Westinghouse Hanford Co., Richland, WA (USA)). Feb 1988. NTIS, PC A06/MF A01. Order Number DE88009043/JAW. (CONF-8710184—).

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

The author discusses the problem of evaluating in-house training programs and/or departments - usually involving Technical Safety Appraisals, QA audits, or Institute of Nuclear Power Operations evaluations. She notes that the usual preparation for these evaluations involves (1) obtaining copies of criteria on standards from the evaluating agency, and (2) training departments trying to interpret these criteria. This is usually unsatisfactory because of (1) vague criteria, and (2) interpreting whether or not the existing way of doing business is in or out of compliance. Having reviewed various criteria, Ms. Birk lists these items as those normally evaluated: (1) Organization, which covers communication and responsibility within a training department; (2) Trainer Qualifications, which covers requirements for trainers; (3) Training Facilities; and (4) Instructional System Design, which is a systematic method for developing lessons of instruction. She devotes most attention here to (4) and its application to writing interpretable standards satisfactory to both the department and the reviewing agency.

9901 Management

REFER ALSO TO CITATION(S) 713, 903, 2570

2668 **(CONF-8802112—1) [A decision model which considers qualitative factors].** Payne, T.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01. Order Number DE89001677/JAW.

From International conference on technology management; Coral Gables, FL, USA (17 Feb 1988).

Today's key business decisions are frequently based solely on the judgement of "technical experts." While this may be the ultimate decision point, a more effective method is to compare the alternate courses of action on the basis of some quantifiable measure. This problem is resolved by developing a mathematical model which includes qualitative factors in a quantitative analysis. 2 tabs.

2669 **(LA—11413-MS) POPA: A Personality and Object Profiling Assistant.** Dreicer, J.S. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 25p. NTIS, PC A03/MF A01. Order Number DE89002090/JAW.

POPA: A Personality and Object Profiling Assistant system utilizes an extension and variation of a process developed for decision analysis as a tool to quantify intuitive feelings and subjective judgments. The technique is based on a manipulation of the Analytical Hierarchy Process. The POPA system models an individual in terms of his character type, life orientation, and incentive (motivational) factors. Then an object (i.e., individual, project, situation, or policy) is modeled with respect to its three most important factors. The individual and object models are combined to indicate the influence each of the three object factors have on the individual. We have investigated this problem: 1) to develop a technique that models personality types in a quantitative and organized manner, 2) to develop a tool capable of evaluating the probable success of obtaining funding for proposed programs at Los Alamos National Laboratory, 3) to determine the feasibility of quantifying feelings and intuition, and 4) to better understand subjective knowledge acquisition (especially intuition). 49 refs., 10 figs., 5 tabs.

2670 **(ORNL/DSRD/TM—24) Overview of the Modern Aids to Planning Program (MAPP) and the role of Martin Marietta Energy Systems, Inc.** Rose, S.D.; Hartley, D.S. III. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01. Order Number DE89001451/JAW.

Effective simulation techniques for activities that involve military planning and analysis are important to the national security of the United States. The Modern Aids to Planning Program (MAPP) is designed to help the Commanders in Chief (CINCs) of the unified and specified commands acquire and apply modern analytical tools to support their ability to develop, analyze, and evaluate operations plans. Timeliness and effectiveness are essential to the mission of the CINCs. Contingency analysis and the development of operations plans, while common to the mission of each of the CINCs, differ in application because of the diversity of the local environments at each CINC location. Martin Marietta Energy Systems, Inc. operates Oak Ridge National Laboratory (ORNL), Oak Ridge Gaseous Diffusion Plant (ORGDP), and other Department of Energy (DOE) facilities. The Data Systems Engineering Organization (DSEO), an element of Martin Marietta Energy Systems, is developing the MAPP concepts: code development, algorithm research, validation, and integration of each of the elements into a consistent program. To prevent expensive and time-consuming model development, a prototyping approach has been adopted to identify effective algorithms that have military realism. An important problem is the determination of the suitability and sensitivity of military data to be used in the validation process. There is a need to make constructing and maintaining the data bases easier and to allow the sharing of common information between model data bases. Another requirement is the clear display and presentation of the relevant information that will enable rapid decision response during exercise of models. 5 refs.

2671 **(PNL-SA—16325) Automated inspection system.** Posakony, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 10p. (CONF-8810207—1). NTIS, PC A02/MF A01. Order Number DE89001486/JAW.

From WEST '88: sensing technology symposium; Seattle, WA, USA (18 Oct 1988).

The pressure of international competition has brought the United States to some sobering realities. The balance of trade is negative and is measured in billions of dollars. The outlook for reaching a balance in the foreseeable future is dismal. In the trade war, a positive outflow, or trade balance, is shown for aircraft and transport equipment, professional, scientific, and control instrumentation and for synthetic resins and plastics. However, the inflow of motor vehicles, telecommunication/sound equipment, iron and steel products, nonferrous metals, electrical machinery, paper and paper board, fibers and textiles, and many other products creates a huge negative balance. This negative balance has caused the US to look inward and outward to determine what steps might be taken to mitigate the problems. The production, quality, and marketing model set by the Japanese is most often referenced as the pattern of the future.

2672 **(RISO-M—2701) Contribution of Risoe National Laboratory to the research and development programs of the Danish Ministry of Energy. Status December 1987.** Skjerk Christensen, P.; Petersen, S. (eds.). (Risoe National Lab., Roskilde (Denmark)). Jun 1988. 80p. (In Danish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88755129/JAW.

EFP.

Since 1978 Risoe has been responsible for a number of projects in the research and development programs of the Danish Ministry of Energy. This report gives a review of current and finished projects. All current projects are described briefly, stating status and results obtained, while the results of finished projects are described in more detail. Risoe's contribution to the organization and the administration of the programs is mentioned. Finally a list of references is given. 11 ills., 34 refs.

2673 **(SAAS-Mitt—87-01) Questions concerning radiation protection in the field of radiometry.** Gruen, W.; Quednau, F.; Wels, Ch. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). 1987. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88704671/JAW.

Based on legal regulations, guidelines, and standards valid in the German Democratic Republic 105 questions concerning radiation protection are answered covering subjects indicated by the following key words and headings: radiometric gages, radiation protection measures, working within protected areas, legal provisions, responsible staff member, radiation protection officer, operating personnel, radiation protection instructions, safe keeping of radiation sources, leak testing, unusual occurrence, transport of radioactive materials, and ceasing of operation.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 1508, 2726, 2733

2674 **(AD-A—195526/9/XAB) Kalman-filter architectures for battle management. Phase 1. Final report.** Satterfield, D. (Systolic Systems, Inc., San Jose, CA (USA)). Jan 1987. 48p. NTIS, PC A03/MF A01.

This report develops a comprehensive theory of parallel Kalman filtering based on a unique decoupling principle permitting the predictor and corrector equations in the filter to be computed in parallel. Highly parallel algorithms and systolic architectures for efficiently implementing these advanced filtering techniques are presented. The application of these methods to Strategic Defense Initiative (SDI) target tracking problems is also described. The PFK theory is well developed, mature and ready to proceed to full-scale validation on a parallel-processing testbed. Because the PFK technology has been needed to solve several applications in the DoD for more than a decade, it is anticipated that, once fully developed, this technology can benefit several sectors of the DoD. This is possible because the necessary technology has only recently been available to transition the PKF theory into practice. Keywords: Computer architecture, Signal processing, Parallel processors.

2675 **(AD-A—195574/9/XAB) Parallelism in solving PDEs (partial differential equations).** Rice, J.R. (Purdue Univ., Lafayette, IN (USA). Dept. of Computer Science). 1986. 9p. NTIS, PC A02/MF A01.

This paper examines the potential of parallel computation methods for partial differential equations (PDEs). The author first observes that linear algebra does not give the best data structures for exploiting parllelism in solving PDEs, the data structures should be based on the physical geometry. There is a naturally high level of parallelism in the physical world to be exploited, and he shows there is a natural level of granularity or degree of parallelism that depends on the accuracy needed and the complexity of the PDE problem. This document explores the inherent complexity of parallel methods and parallel machines and conclude that dramatically increased software support is needed for the general scientific and engineering commmunity to exploit the power of highly parallel machines.

2676 **(AD-A—195825/5/XAB) Simple example of an SADMT SDI-(Strategic Defense Initiative) Architecture Dataflow Modeling Technique) architecture specification. Version 1.5. Final report.** Linn, C.J.; Linn, J.L.; Edwards, S.H.; Kappel, M.R.; Ardoin, C.D. (Institute for Defense Analyses, Alexandria, VA (USA)). 21 Apr 1988. 72p. (IDA-P—2036). NTIS, PC A04/MF A01.

This report presents a simple architecture specification in the SDI Architecture Dataflow Modeling Technique (SADMT). The example code is given in the SADMT Generator (SAGEN) Language. This simple architecture includes (1) an informal description of the architecture, (2) the main program that creates the components of the simulation, (3) the specification of the BM/C3 logical processes of the architecture, (4) the specification of the Technology Modules (TMs) of the architecture, and (5) the specification of the Battle Management/Command, Control and Communications (BM/C3) and TMs of the threat.

2677 **(AD-A—195858/6/XAB) Sagen (SADMT (Strategic Defense Initiative Architecture Ddataflow Modeling Technique) generator) user's guide Version. 1.5. Final report.** Kappel, M.R.; Ardoin, C.D.; Linn, C.J.; Linn, J.L.; Salasin, J. (Institute for Defense Analyses, Alexandria, VA (USA)). Apr 1988. 48p. (IDA-P—2028). NTIS, PC A03/MF A01.

IDA Paper P-2028 documents a tool that can facilitate the description of processes for the Strategic Defense System (SDS) and Battle Management/Command, Control and Communications (BM/C3) architectures. The process descriptions generated by this tool conform to the Strategic Defense Initiative (SDI) Architecture Dataflow Modeling Technique (SADMT).

2678 **(AD-A—195925/3/XAB) Hough transform has O(N) complexity on SIMD N x N mesh array architectures. Technical report.** Cypher, R.E.; Sanz, J.L.; Snyder, L. (Washington Univ., Seattle (USA). Dept. of Computer Science). Jul 1987. 8p. NTIS, PC A02/MF A01.

This paper reports on new algorithms for computing the Hough transform on mesh-array architectures. The mesh is fine-grained, consisting of an N x N array of processors, each holding a single pixel of the image. The mesh array operates in an SIMD mode. Several algorithms, differing in the techniques they use, their asymptotic complexity, or the architectural resources required, are presented for computing the Hough transform. The main algorithm computes any P angles of the Hough transform in O(N + P) time and used only a constant amount of memory per processor. All the algorithms apply to the more general problem of computing the Radon transform of gray-level images.

2679 **(AD-A—196075/6/XAB) Temporal knowledge representation and reasoning for project planning. Final report, 1 February 1987-31 January 1988.** Bell, C.E. (Iowa Univ., Iowa City (USA). Dept. of Management Sciences). 24 Apr 1988. 6p. NTIS, PC A02/MF A01.

The author has written a working computer program that allows a user (or a different module of an AI planning program) to specify a set of temporal constraints including disjunctive constraints. In the context of a point-based temporal model, the program has required several innovative design choices. The program will find a feasible solution to the constraints if one exists, otherwise it will identify a contradiction. It is especially appropriate when adding new constraints to currently satisfiable existing constraints. The philosophical approach of dependency-directed backtracking is employed. This is implemented in a way that takes account of the problem's special structure. The program is particularly successful in certain examples for which chronological backtracking would be hopelessly inefficient. Other notorious examples require time-consuming search. These examples reveal important tradeoffs between explicitly storing temporal knowledge and deriving appropriate temporal knowledge on demand. Particular instances were identified where explicit storage is critical for avoiding expensive search.

2680 **(AD-A—196102/8/XAB) Parallel algorithms for Groebner-basis reduction. Technical report, 7 August 1984-6 August 1987.** Ponder, C. (California Univ., Berkeley (USA). Dept. of Electrical Engineering and Computer Sciences). 25 Sep 1987. 20p. NTIS, PC A03/MF A01.

A variety of ways is presented to parallelize Groebner-basis reduction, ranging from incorrect to ineffectual. The superiority is demonstrated of the method used by Zacharias, which is not readily parallelizable. The efficiency issues of generating reduced Groebner-bases, is discussed.

2681 **(AD-A—196109/3/XAB) Resource allocations and expert systems. Final report.** (JAYCOR, Alexandria, VA (USA)). 12 May 1988. 36p. NTIS, PC A03/MF A01.

The work performed to meet the requirement of this task is a continuing effort, evolving toward a general-purpose reasoning tool. The idea here is to build a more-powerful general expert system than the previous one. Towards that, this new Bayesian inference engine is based on the work done by Pearl and Kim. The advantages of this new inference engine over the previous one are that the representation of the knowledge is more compact and the inferencing is suitable for parallel processing. The inference engine is written in Franz lisp on VAX machine. All the code and a typescript of how to load and use the system is attached.

2682 **(AD-A—196205/9/XAB) Very large parallel data flow. Final report, December 1985-December 1987.** Ramnarayan, R.; Baker, C.; Lu, H.; Mikkilineni, K.; Richardson, J. (Honeywell, Inc., Golden Valley, MN (USA). Corporate Systems Development Div.). Mar 1988. 287p. NTIS, PC A13/MF A01.

This report describes a three-phase effort to investigate the use of parallel processing in very large data/knowledge data-base management systems (D/KBMS) as a means of attaining required performance levels. Phase one involved investigation of parallel-processing techniques for inference processing, parallel processing techniques for very large database management and fault-tolerant techniques for very large data-bases. During phase two, the results of ix investigation studies were combined to develop a methodology for specifying high-performance, highly available D/KBMS computer architecture for very large data/knowledge base (D/KB) environments. During phase three, a data/knowledge base management testbed was designed and implemented to serve both as a demonstration and performance measurement and evaluation platform. The testbed was used to perform several experiments designed to quantitatively measure D/KBMS performance and understand D/KBMS performance sensitivity and behavior with respect to various system paramounts. Several key results and conclusions have been identified from this work and directions for future work have been identified.

2683 **(ANL/TM—379-Rev.1) Recommended documentation for computer users at ANL.** Caruthers, C.M.; Opitz, L.C.; Walsh, D.J. (Argonne National Lab., IL (USA)). Oct 1988. Contract W-31109-ENG-38. 98p. NTIS, PC A05/MF A01. Order Number DE89002465/JAW.

Recommended Documentation for Computer Users at ANL is for all users of the services available from the Argonne National Laboratory Computing and Telecommunications Division. This manual will guide you in selecting available documentation that will best fill your particular needs. Chapter 1 tells you how to use this document to select manuals and how to obtain them from the Computing and Telecommunications Document Distribution Counter. Chapter 2 contains tables that categorize available publications and identify available computer systems, applications, lan-

guages, and libraries. Chapter 3 lists publications by subject, with annotations indicating the skill level. Chapter 4 contains abstracts of each publication, arranged alphabetically. Chapter 5 describes additional publications that contain bibliographies and master indices.

2684 **(ANL/TM—459-Rev.1) Survey of ANL organization plans for word processors, personal computers, workstations, and associated software.** Opitz, L.C.; Slocum, R.E.; Walsh, D.J. (Argonne National Lab., IL (USA)). Oct 1988. Contract W-31109-ENG-38. 85p. NTIS, PC A05/MF A01. Order Number DE89002384/JAW.

To provide DOE with an understanding of recent growth in the acquisition and use of personal computers, microcomputers, and word processors at ANL, the Computing and Telecommunications Division has compiled this Survey of ANL Organization Plans for Word Processors, Personal Computers, Workstations, and Associated Software (ANL/TM 459, Revision 1). This information is current as of September 1988. This document supersedes the first survey (ANL/TM 459). The specific purposes of this Survey are to document each organization's plans for office automation, to identify appropriate planners and other contact people in those organizations, and to promote the sharing of this information among those people making plans for organizations and decisions about office automation. The Survey supplements information in both the ANL Statement of Site Strategy for Computing Workstations (ANL/TM 458) and the Site Response for the DOE Information Technology Resources Long-Range Plan (ANL/TM 449). This Survey is also for Laboratory planners, service providers, and people involved in office automation; it is for internal use only.

2685 **(CONF-881140—3) Self-motion determination based on joint velocity bounds for redundant robots.** Euler, J.A.; Dubey, R.V.; Babcock, S.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88012488/JAW.

From 2. international symposium on robotics and manufacturing research, education and applications; Albuquerque, NM, USA (16 Nov 1988).

The movement of redundant robot joints that does not cause any end-effector motion is referred to as self-motion. Control schemes for redundant robots utilize self-motion to optimize a performance criterion. Thus, commanded joint motion at each sampling step is the sum of the minimum joint motion required for the desired end-effector motion and the self-motion. However, the amount of self-motion is limited by the bounds on joint velocities. A scheme is presented to determine the magnitude of self-motion, the direction of which is determined by a gradient projection scheme. Implementation of this scheme on a Motorola 68020 VME bus-based controller of the seven-degree-of-freedom manipulator at the ORNL Center for Engineering Systems Advanced Research (CESAR) is described. 8 refs., 2 figs.

2686 **(CONF-881188—1) The Aurora or-parallel Prolog system.** Lusk, E.; Butler, R.; Disz, T.; Olson, R.; Overbeck, R.; Stevens, R.; Warren, D.H.D.; Calderwood, A.; Szeredi, P.; Haridi, S. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 19p. NTIS, PC A03/MF A01. Order Number DE89000537/JAW.

From 5. Generation Computer Systems international conference; Tokyo, Japan (28 Nov 1988).

Aurora is a prototype or-parallel implementation of the full Prolog language for shared-memory multiprocessors, developed as part of an informal research collaboration known as the "Gigalips Project". It currently runs on Sequent and Encore machines. It has been constructed by adapting Sicstus Prolog, an existing, portable, state-of-the-art, sequential Prolog system. The techniques for constructing a portable multiprocessor version follow those pioneered in a predecessor system, ANL-WAM. The SRI model was adopted as the means to extend the Sicstus Prolog engine for or-parallel operation. We describe the design and main implementation features of the current Aurora system, and present some preliminary experimental results. We conclude with our plans for the continued development of the system and an outline of future research directions. 20 refs.

2687 **(CONF-8608232—, pp vp) Evolution of a family of image processing systems at INPE.** Modestodesouza, R.C.; Mendes, C.L.; Pintodegarrido, J.C.; Neto, G.C. 1986. (In several languages). NTIS, PC A99/MF E03.

From 4. Brazilian remote sensing symposium and 6. SELPER plenary meeting; Gramado, Brazil (10 Aug 1986).

The proposed evolution, in the next few years, for the family of image processing systems under development at MCT/INPE is described. The family comprises several configurations with various price/performance relations. The basic characteristics of the members of the family are presented; technological trends which will influence future members of the family are discussed, such as VLSI architecture, graphical techniques, and parallel processing.

2688 **(CONF-8804183—2) A Bayesian approach to the design and analysis of computational experiments.** Mitchell, T.J.; Morris, M.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE89001518/JAW.

From 20. symposium on the interface: computing science and statistics; Washington, DC, USA (20 Apr 1988).

In a computational experiment, the data are produced by a computer program that models a physical system. The experiment consists of a set of model runs; the design of the experiment specifies the choice of program inputs for each run. This paper centers on the problem of prediction (interpolation), the goal of which is to devise a design/analysis method which will provide predictions of model output for input values not run. We adopt a Bayesian approach as the basis for the analysis. Uncertainty about the response function is quantified by choosing a class of probability distributions over the function space. This leads to design procedures based on maximizing the expected reduction in "amount of uncertainty," where the latter can be defined formally in terms of properties of the posterior distribution. Here we use as a design optimality criterion the determinant of the posterior covariance matrix of the responses at the input configurations at which we want to make predictions. This requires maximization of the determinant of the prior covariance matrix of the responses at the design sites. We describe our computer algorithm for constructing optimal designs, and give some examples of designs that it produces. 9 refs., 1 fig., 1 tab.

2689 **(CONF-8810168—1) Recent CESAR [Center for Engineering Systems Advanced Research] research activities in sensor based reasoning for autonomous machines.** Pin, F.G.; de Saussure, G.; Spelt, P.F.; Killough, S.M.; Weisbin, C.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02. Order Number DE88017364/JAW.

From International workshop on intelligent robots and systems; Tokyo, Japan (31 Oct 1988).

This paper describes recent research activities at the Center for Engineering Systems Advanced Research (CESAR) in the area of sensor based reasoning, with emphasis being given to their application and implementation on our HERMIES-IIB autonomous mobile vehicle. These activities, including navigation and exploration in a-priori unknown and dynamic environments, goal recognition, vision-guided manipulation and sensor-driven machine learning, are discussed within the framework of a scenario in which an autonomous robot is asked to navigate through an unknown dynamic environment, explore, find and dock at the panel, read and understand the status of the panel's meters and dials, learn the functioning of a process control panel, and successfully manipulate the control devices of the panel to solve a maintenance emergency problems. A demonstration of the successful implementation of the algorithms on our HERMIES-IIB autonomous robot for resolution of this scenario is presented. Conclusions are drawn concerning the applicability of the methodologies to more general classes of problems and implications for future work on sensor-driven reasoning for autonomous robots are discussed. 8 refs., 3 figs.

2690 **(CONF-8810178—2) Hardware, software, and practical experience: A workshop for users of Ventura Publisher{trademark}.** Hayhoe, G.F.; Hughes, S.E. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01. Order Number DE89000452/JAW.

From 12. annual practical conference on communication; Oak Ridge, TN, USA (13 Oct 1988).

This workshop will provide a forum by which users of Ventura Publisher (VP) can exchange information gained through experience with and study of VP. Discussion will focus on achieving production efficiency through equipment and know-how. Hardware topics will include monitors, expansion boards, scanners, printers; software discussion will address word processing, graphics, fonts, and cache programs. Areas for sharing tips and skills include style sheets, file management, effective use of VP specialties, and suggestions for handling its peculiarities. Participants will be provided with a bibliography of current source materials. 12 refs.

2691 **(CONF-8810187—1) Why are computer systems so difficult to build?.** Hardee, J.L.; Voelker, A.H. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01. Order Number DE89001204/JAW.

From 24. annual meeting of the Institute of Management Science - Southeastern Chapter; Myrtle Beach, SC, USA (6 Oct 1988).

The difficulties experienced in computer systems development have been widely documented and discussed over the past two decades. According to a recent survey, 75 percent of all systems development efforts are either never completed or, if completed, never used. There is a growing consensus that most computer system problems relate to social rather than technical aspects of systems development and implementation. This paper argues that the development success rate can be improved, but only after a broader conceptual view of systems development matures that is sensitive to social, organizational, and political issues. Furthermore, this conceptual view can only be developed after we have destroyed some of the fallacies in current systems development practice that are largely responsible for the insensitivity to these issues. The paper lists and describes some of the most serious of these fallacies. 15 refs.

2692 **(DOE/ER/25001—25) [Parallel processing research and development (Section II only)]: Progress report.** Kuck, D.J. (Illinois Univ., Chicago (USA)). 1988. Contract FG02-85ER25001. 23p. NTIS, PC A03/MF A01. Order Number DE89002016/JAW.

In this paper we will outline our progress since the beginning of the Cedar Project, and briefly describe specific Cedar work that remains to be done. Some specific topics discussed are: Center for Superconductivity Research and Development (CSRD) developed boards and physical equipment; operating system; languages and compilers; multiprocessor performance on applications and algorithms; and highlights of future work.

2693 **(DOE/ER/25050—1) Third SIAM conference on parallel processing for scientific computing: Final program.** (Society for Industrial and Applied Mathematics, Los Angeles, CA (USA)). 1987. Contract FG02-87ER25050. 68p. (CONF-871251—Absts.). NTIS, PC A04/MF A01. Order Number DE88017259/JAW.

From 3. SIAM conference on parallel processing for scientific computing; Los Angeles, CA, USA (1 Dec 1987).

This paper contains general information on the third SIAM conference on parallel processing for scientific computing. Abstracts of the papers on parallel processing architecture are listed. (LSP)

2694 **(DP-MS—88-207) Electronic input/output: Videotext preparation.** Chavis, D. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 14p. (CONF-881122—1). NTIS, PC A03/MF A01. Order Number DE89002025/JAW.

From DOE forum on computer systems for documentation; Bodega Bay, CA, USA (1 Nov 1988).

One of the goals of the Computer Projects Department (CD), at the Savannah River Plant (SRP), is to provide a computer user with the capability of retrieving information electronically. DEC Videotext was chosen as a means to achieve this goal. It can be accessed from ALL-IN-1, a large site network provided by Digital Corporation that provides a consistent user interface for different kinds of workstations located across the SRP site. Videotext uses a menu- driven interface for retrieving pages of information. These pages many contain either text or graphics. However, because of the different types of workstations used at SRP, CD does not currently support graphics.

2695 **(JAERI-M—88-104) Thermal radiation view factor calculation using Monte Carlo method.** Ikushima, Takeshi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Jun 1988. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88755212/JAW.

It is necessary to obtain the radiation geometric view factor for calculation of radiation heat transfer problems. There are many studies for calculation methods of the view factors. That are area integration method, line integration method, Mitalas and Stephenson's contour integration method, Hottel's cross-string method and Monte Carlo method. The view factors can be calculated by area integration method and Monte Carlo method, when third surface shading exists. The report is comparative study of the calculation accuracy and computer time between area integration method and Monte Carlo method for view factors. It has been considered that Monte Carlo method is time consuming. However it is clarified from the results that a small amount of emission leads to reasonable view factors and small amount of computer time. Moreover using Monte Carlo method, view factors of multi-body system could be easily obtained through only one computing execution.

2696 **(KFKI—1987-02/M) Integrating declarative knowledge programming styles and tools for building expert systems.** Barbuceanu, M.; Trausan-Matu, S.; Molnar, B. (Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics). 1987. 44p. (CONF-8705333—1). NTIS (US Sales Only), PC A03. Order Number DE88015970/JAW.

From Expert systems and their applications; Avignon, France (13 May 1987).

The XRL system reported in this paper is an integrated knowledge programming environment whose major research theme is the investigation of declarative knowledge programming styles and features and of the way they can be effectively integrated and used to support AI programming. This investigation is carried out in the context of the structured-object representation paradigm which provides the glue keeping XRL components together. The paper describes several declarative programming styles and associated support tools available in XRL. These include an instantiation system supporting a generalized view of the ubiquous frame installation process, a description based programming system providing a novel declarative programming style which embeds a mathematical oriented description language in the structured object environment and a transformational interpreter for using it, a semantics oriented programming framework which offers a specific semantic construct based approach supporting maintenance and evolution and a self description and self generation tool which applies the latter approach to XRL itself. 29 refs., 16 figs.

2697 **(LA-UR—88-890) Design and implementation of a supercomputer frame buffer system.** Fowler, J.D. Jr.; McGowen, M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 25p. (CONF-881112—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007834/JAW.

From Supercomputing conference; Orlando, FL, USA (14 Nov 1988).

A 512 by 512 pixel by 8 bits per pixel frame buffer has been designed, constructed, and installed on a 48 Mbit/s I/O channel of a Cray X-MP 4/16 supercomputer. This project was undertaken to test whether such a system would be useful and, if so, how it would be used. Supporting software provides the ability to convert vector graphics description files into raster format, to show raster movies interactively, and to show vector files by real-time conversion from vector to raster formats. We have shown that real-time animations in an interactive supercomputer environment are feasible and useful with this system. 6 refs., 3 figs.

2698 **(LA-UR—88-2391) Performance comparison of the CRAY-2 and CRAY X-MP/416 supercomputers.** Simmons, M.L.; Wasserman, H.J. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-881112—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014338/JAW.

From Supercomputing conference; Orlando, FL, USA (14 Nov 1988).

The serial and parallel performance of one of the world's fastest general purpose computers, the CRAY-2, is analyzed using the standard Los Alamos Benchmark Set plus codes adopted for parallel processing. For comparison, architectural and performance data are also given for the CRAY X-MP/416. Factors affecting performance, such as memory bandwidth, size and access speed of memory, and software exploitation of hardware, are examined. The parallel processing environments of both machines are evaluated, and speed-up measurements for the parallel codes are given. 14 refs., 2 figs., 9 tabs.

2699 **(LA-UR—88-2454) A scientific visualization workbench.** Phillips, R.L. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-881112—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88014397/JAW.

From Supercomputing conference; Orlando, FL, USA (14 Nov 1988).

A system for visualization of data from supercomputer simulations has been developed for use by scientists and engineers at Los Alamos National Laboratory. The scientific visualization workbench, as the system is called, is based on an industry standard workstation (a Sun 3/160C), the NeWS window system, and a video/graphics add-in card, which is supported by NeWS. Also involved is a frame buffer attached to a 48-Mbit/s Cray channel and a video link from the frame buffer to the Sun workstation. Computation and graphics preparation are performed on the Cray under the control of a NeWS client program. Images are rasterized and sent to the workstation at the rate of 25 frames/s. The workbench permits the scientist to converse with applications running on a Cray but still retain the convenience and flexibility of a personal workstation environment. Moreover, the video link allows animated graphics images to be displayed on the workstation at a much higher rate than would be possible with a conventional network connection, i.e., Ethernet. Also, NeWS affords the convenience of a modern window system. Live videos can be displayed in a window anywhere on the screen, while other windows may contain conventional text or graphics. 8 refs., 6 figs.

2700 **(LA-UR—88-2752) Profiles in mass storage: A tale of two systems.** Collins, M.W.; Devaney, M.; Kitts, D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-881112—8). NTIS, PC A02/MF A01. Order Number DE89000393/JAW.

From Supercomputing conference; Orlando, FL, USA (14 Nov 1988).

The Los Alamos Common File System (CFS) and the NCAR Mass Storage System (MSS) are file storage and file management systems that serve heterogeneous computing networks of supercomputers, general purpose computers, scientific workstations and personal computers. This paper details philosophical, implementation and performance aspects of the two mass storage systems. Areas covered include the computing environment, the user interface, storage strategies and file movement strategies. 6 refs., 2 figs.

2701 **(LA-UR—88-3126) POPART: Performance OPtimized Algebraic Reconstruction Techniqu.** Hanson, K.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-881189—1). NTIS, PC A02/MF A01. Order Number DE89000346/JAW.

From Visual communications and image processing; Cambridge, MA, USA (9 Nov 1988).

A method for optimizing image-recovery algorithms is presented that is based on how well a specified visual task can be performed using the reconstructed images. Visual task performance is numerically assessed by a Monte Carlo simulation of the complete imaging process including the generation of scenes appropriate to the desired application, subsequent data taking, image recovery, and performance of the stated task based on the final image. This method is used to optimize the Algebraic Reconstruction Technique (ART), which reconstructs images from their projections, by varying the relaxation factor employed in the updating procedure. In some of the imaging situations studied, it is found that the optimization of constrained ART, in which a nonnegativity constraint is invoked, can vastly increase the detectability of objects. There is little improvement attained for unconstrained ART. 2 refs., 5 figs., 2 tabs.

2702 **(LBL—24727) Advances in high-resolution image simulation.** O'Keefe, M.A.; Kilaas, R. (Lawrence Berkeley Lab., CA (USA)). Sep 1988. Contract AC03-76SF00098. 40p. (CONF-8804206—1). NTIS, PC A03/MF A01. Order Number DE89000569/JAW.

From 6. Pfefferkorn conference; Niagara Falls, NY, USA (28 Apr 1988).

Continuing advances in hardware and software have improved both the speed and the range of computations that can be made to simulate high resolution electron microscope (HREM) images from various structures. Use of image display systems and array processors have made the image simulation procedure much more interactive while laser printers provide a fast high-quality hard copy output. Use of array processors has enabled the rewriting of electron scattering algorithms to include convergence effects (previously only considered after the scattered electron beams had emerged from the specimen) and upper-layer-line effects. With an array processor it is faster to compute effects of spatial and temporal coherence in real space, rather than use approximation solutions derived from series expansion in reciprocal space. With a frame buffer and suitable software the use has the facility to change parameters and view the results of the change almost immediately. Selected images can then be directed to hard copy output, in contrast with batch methods where series of hard copy images are produced and then selected from. Given a microdensitometer for input of experimental images from plates, or a video camera attached to the electron microscope and a frame buffer, split screen comparisons between experimental and computed images are possible, including independent control of image contrast, magnification and orientation. 23 refs., 19 figs., 2 tabs.

2703 **(LBL—24996) Distributed scientific video movie making.** Johnston, W.E.; Hall, D.E.; Huang, J.; Rible, M.; Robertson, D. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 8p. (CONF-881130—1). NTIS, PC A02/MF A01. Order Number DE88014858/JAW.

From The supercomputing conference; Kissimmee, FL, USA (14 Nov 1988).

We describe a versatile, low cost, video movie making system for generating and displaying scientific graphics from remote supercomputers. The system makes video movies by single frame animation from the output of time dependent, numerical simulations typically done on supercomputers. The system uses extensive data compression to permit its use over wide area, as well as local area networks. The system demonstrates an easily used, elementary visualization capability for time dependent data in a heterogeneous, distributed computing environment. 18 refs., 2 figs., 1 tab.

2704 **(LBL—25279) Encouraging mature user behaviour in the end-user computing environment.** Stevens, D.F. (Lawrence Berkeley Lab., CA (USA)). Jun 1988. Contract AC03-76SF00098. 11p. (CONF-881137—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88012019/JAW.

From Pergamon infotech state-of-the-art review; London, UK (16 Nov 1988).

This paper discusses the importance of using computer environments as efficiently as possible. Examples are given, and training is suggested. (LSP)

2705 **(N—88-25191) Algorithms and software for solving finite element equations on serial and parallel architectures. Final report.** Chu, E.; George, A. (Tennessee Univ., Knoxville (USA)). Jun 1988. 135p. (NASA-CR—183027; NAS—1.26:183027). NTIS, PC A07/MF A01.

The primary objective was to compare the performance of state-of-the-art techniques for solving sparse systems with those that are currently available in the Computational Structural Mechanics (MSC) testbed. One of the first tasks was to become familiar with the structure of the testbed, and to install some or all of the SPARSPAK package in the testbed. A brief overview of the CSM Testbed software and its usage is presented. An overview of the sparse matrix research for the Testbed currently employed in the CSM Testbed is given. An interface which was designed and implemented as a research tool for installing and appraising new matrix processors in the CSM Testbed is described. The results of numerical experiments performed in solving a set of testbed demonstration problems using the processor SPK and other experimental processors are contained.

2706 **(ORNL—6498) A Bayesian approach to the design and analysis of computer experiments.** Currin, C.; Mitchell, T.; Morris, M.; Ylvisaker, D. (Oak Ridge National Lab., TN (USA)). Sep 1988. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01. Order Number DE89001949/JAW.

We consider the problem of designing and analyzing experiments for prediction of the function y(t), tϵT, where y is evaluated by means of a computer code (typically by solving complicated equations that model a physical system), and T represents the domain of inputs to the code. We use a Bayesian approach, in which uncertainty about y is represented by a spatial stochastic process (random function); here we restrict attention to stationary Gaussian processes. The posterior mean function can be used as an interpolating function, with uncertainties given by the posterior standard deviations. Instead of completely specifying the prior process, we consider several families of priors, and suggest some cross-validational methods for choosing one that performs relatively well on the function at hand. As a design criterion, we use the expected reduction in the entropy of the random vector y(T*), where T*⊂T is a given finite set of "sites" (input configurations) at which predictions are to be made. We describe an exchange algorithm for constructing designs that are optimal with respect to this criterion. To demonstrate the use of these design and analysis methods, several examples are given, including one experiment on a computer model of a thermal energy storage device and another on an integrated circuit simulator. 23 refs., 14 figs., 1 tab.

2707 **(ORNL/CSD/TM—262/1) Series/1 and 7171 quick reference manual.** (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01. Order Number DE89001945/JAW.

This manual provides keyboard configurations for terminals that can be used to access the IBM Series/1 Yale ASCII Terminal Communications System (Series/1) and the IBM 7171 ASCII Device Attachment Control Unit (7171). Some access information specific to use of Series/1 and 7171 on the Martin Marietta Energy Systems, Inc. central computer systems is also included.

2708 **(ORNL/TM—10865) Solution of sparse positive definite systems on a hypercube.** George, A.; Heath, M.; Liu, J.; Ng, E. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01. Order Number TI89001878/JAW.

The solution of large sparse positive definite systems of equations typically involves four steps: ordering, data structure setup (symbolic factorization), numerical factorization, and triangular solution. This article describes how these four phases are implemented on a hypercube multiprocessor. The role of elimination trees in the exploitation of sparsity and the identification of parallelism is explained, and pseudo-code algorithms are provided for some of the important algorithms. Numerical experiments run on an Intel iPSC multiprocessor are presented in order to provide some indication of the performance of the various algorithms. 36 refs., 23 figs., 5 tabs.

2709 **(ORNL/TM—10913) Options for improving computing and data system support for HQ USTRANSCOM [Headquarters, US Transportation Command] deployment planning.** (Oak Ridge National Lab., TN (USA)). 1 Aug 1988. Contract AC05-84OR21400. 49p. NTIS, PC A03/MF A01. Order Number DE89002374/JAW.

The Decision Systems Research Section of the Oak Ridge National Laboratory (ORNL) is assisting the Deployment Systems Division of the Headquarters, US Transportation Command (HQ USTRANSCOM) with an evaluation of options for improving the computing and data systems support for deliberate and time-critical joint deployment planning. USTRANSCOM, which is a unified command (i.e., personnel are drawn from all the services), was created in the fall of 1987 to consolidate the functions of the former military transportation operating agencies (the Military Airlift Command, the Military Traffic Management Command, and the Military Sealift Command). An important factor in the creation of USTRANSCOM was the possibility of achieving more efficient joint deployment planning through consolidation of the computing and data systems used by the command's strategic mobility planners and operation center personnel. This report, the third in a series to be produced in the course of ORNL studies for USTRANSCOM, presents options for improving automation support for HQ USTRANSCOM deployment planning. The study covered methods for improving data concepts used in deployment databases, recommendations for extending the life of the Joint Deployment system, and alternatives for integrating HQ USTRANSCOM planning support with systems at MAC, MTMC, and MSC. 36 refs.

2710 **(ORNL/TM—10945) Limits on parallelism in the numerical solution of linear PDEs.** Worley, P.H. (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01. Order Number DE89002403/JAW.

We consider approximating the solution of a linear scalar partial differential equation (PDE) at a single location in its problem domain. In previous work we described a lower bound on the amount of data required to satisfy an error bound for the approximation. Using this bound, we derive a lower bound on the parallel complexity of algorithms that approximate the solution. The lower bound is a linear function of log$_{\epsilon}$ϵ/sup {minus}1/, where ϵ is an upper bound on the error. Thus, the parallel complexity increases as ϵ decreases, independent of the number of processors, the interconnection topology, and the algorithm used. We also describe how the lower bound changes when the interconnection network or the number of processors in specified. Recent research has established that it is often possible to use a large number of processors efficiently when calculating the numerical solution of a PDE if the problem is sufficiently large. We argue that increasing the size of such a problem will usually come at the cost of increasing the execution time. We describe two examples verifying this conclusion, an algorithm-independent analysis of an elliptic PDE and an analysis of a specific algorithm for the approximation of a hyperbolic PDE. 16 refs., 4 figs.

2711 **(PB—88-235817/XAB) 64-Bit minisupercomputer.** Heard, H.G. (ZeroOne Systems, Inc., Santa Clara, CA (USA)). 31 Jul 1985. 40p. NTIS, PC A03/MF A01.

The project has sought to determine the feasibility of the construction of a modest-performance, stand-alone, 64-bit, vector-processing mini-supercomputer system, with a compatible-register architecture, and instruction set that would execute the identical object code of the target supercomputer. This would be a 1% supercomputer, offering 1% of the performance at 1% of the cost of the high-performance supercomputer. Its primary thrust would be to support software code development and user training for the target supercomputer. An analysis of state-of-the-art supercomputers has led to the determination that the ETA-10 supercomputer would be an ideal target supercomputer. A thorough analysis of the architecture and instruction set of the ETA-10, and implementation technology has demonstrated that it is not only technically feasible, but highly attractive to commence the further research and development of a 64-bit mini-supercomputer targeted at the ETA-10.

2712 **(PB—88-868807/XAB) Parallel computer architecture. January 1975-September 1987 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-September 1987.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 136p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the development and performance analysis of parallel architecture in image processing and computing. Cost and performance evaluations of multiple-processor systems are described. Applications include supercomputer design, data base management, computer communication systems, and robot control. (This updated bibliography contains 275 citations, none of which are new entries to the previous edition.)

2713 **(PB—88-868815/XAB) Parallel computer architecture. October 1987-September 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for October 1987-September 1988.** (National Technical Information Service, Springfield, VA (USA)). Sep 1988. 111p. NTIS PC N01/MF N01.

Supersedes PB—87-867404.

This bibliography contains citations concerning the development and performance analysis of parallel architecture in image processing and computing. Cost and performance evaluations of multiple processor systems are described. Applications include supercomputer design, data-base management, computer communication systems, and robot control. (This updated bibliography contains 206 citations, all of which are new entries to the previous edition.)

2714 **(PNL-SA—15508) An expert system for dispersion model interpretation.** Skyllingstad, E.D.; Ramsdell, J.V. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1988. Contract AC06-76RL01830. 11p. (CONF-880913—4). NTIS, PC A03/MF A01. Order Number DE89001745/JAW.

From ANS topical meeting on emergency response: planning, technologies and implementations; Charleston, SC, USA (26 Sep 1988).

A prototype expert system designed to diagnose dispersion model uncertainty is described in this paper with application to a puff transport model. The system obtains qualitative information from the model user and through an expert-derived knowledge base, performs a rating of the current simulation. These results can then be used in combination with dispersion model output for deciding appropriate evacuation measures. Ultimately, the goal of this work is to develop an expert system that may be operated accurately by an individual uneducated in meteorology or dispersion modeling. 5 refs., 3 figs

2715 **(SAND—88-0875) XPRT: An expert system shell.** Cochrell, G.D. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1988. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01. Order Number DE89001839/JAW.

XPRT is a rule-based expert system shell written in the C programming language. This report contains a detailed description of the commands available in XPRT and also describes the syntax rules needed to construct a knowledge base. The shell's source code uses standard ANSI C, which allows it to run on any computer that can compile a C program. The executable code occupies 70K of PC memory. XPRT's inference engine can be commanded to backward chain or forward chain. Heuristics may be employed to reduce the search space of knowledge base rules. XPRT can read and write external files and spawn processes. The shell is mainly a symbolic processor but can handle numerical data as well. A mechanism of weighted facts and rules is used as an approach for handling uncertainty. XPRT is a no-frills shell with some very practical commands. The shell was used to write an expert system that is currently scheduling over a dozen software programs to maintain and manage a large departmental database. XPRT continues to evolve, and our organization is finding the shell to be a valuable programming tool. 6 refs.

2716 **(SAND—88-2796C) The modular building block data bus: A facilitator of C3I system integration and packaging.** Longoria, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-881194—1). NTIS, PC A02/MF A01. Order Number DE89001614/JAW.

From 8. annual international electronics packaging conference; Dallas, TX, USA (7 Nov 1988).

For the past several years, the Defense Communications Agency along with Sandia National Laboratories and the Mitre Corporation have been involved in designing and building Command, Control, and Communications and Intelligence (C3I) systems using an approach called the Modular Building Block (MBB) concept. This approach has been used to solve a number of basic problems which have been associated with the design and production of mobile C3I systems. 2 figs.

2717 **(SAND—88-2894C) Automated quadrilateral mesh generation: A knowledge system approach.** Blacker, T.D.; Stephenson, M.B.; Mitchiner, J.L.; Phillips, L.R.; Lin, Y.T. (Sandia National Labs., Albuquerque, NM (USA)). 14 Oct 1988. Contract AC04-76DP00789. 29p. (CONF-881120—16). NTIS, PC A03/MF A01. Order Number DE89001678/JAW.

From ASME winter annual meeting; Chicago, IL, USA (28 Nov 1988).

This paper presents a knowledge system approach to automated 2-D quadrilateral mesh generation. This approach mimics the most popular technique currently used by analysts for all-quadrilateral mesh generation, that of decomposing an arbitrary geometry into subregions for mapping. We enumerate the merits of this approach over other automated mesh generation techniques and discuss the basic philosophy and structure of the knowledge system and its tie to enhanced mapping algorithms. Examples of automatically generated meshes are presented and compared with analysts' generated meshes as an indication of the capability of this approach. 15 refs. 12 figs.

2718 **(SOL—88-16) Algorithms for nonlinear least-squares problems.** Fraley, C. (Stanford Univ., CA (USA). Systems Optimization Lab.). Sep 1988. Contract FG03-87ER25030. 49p. NTIS, PC A03/MF A01. Order Number DE89001769/JAW.

This paper addresses the nonlinear least-squares problem min/sub xε{Re}{sup n}/{parallel}f(x){parallel}$_2^2$, where f(x) is a vector in {Re}/sup m/ whose components are smooth nonlinear functions. The problem arises most often in data fitting applications. Much research has focused on the development of specialized algorithms that attempt to exploit the structure of the nonlinear least-squares objective. We survey numerical methods developed for problems in which sparsity in the derivatives of f is not taken into account in formulating algorithms. 85 refs.

2719 **(SOL—88-17) Software performance on nonlinear least-squares problems.** Fraley, C. (Stanford Univ., CA (USA). Systems Optimization Lab.). Sep 1988. Contract FG03-87ER25030. 118p. NTIS, PC A06/MF A01. Order Number DE89001867/JAW.

This paper presents numerical results for a large and varied set of problems using software that is widely available and has undergone extensive testing. The algorithms implemented in this software include Newton-based linesearch and trust-region methods for unconstrained optimization, as well as Gauss-Newton, Levenberg-Marquardt, and special quasi-Newton methods for nonlinear least squares. Rather than give a critical assessment of the software itself, our original purpose was to use the best available software to compare the underlying algorithms, to identify classes of problems for each method on which the performance is either very good or very poor, and to provide benchmarks for future work in nonlinear least squares and unconstrained optimization. The variability in the results made it impossible to meet either of the first two goals; however, the results are significant as a step toward explaining why these aims are so difficult to achieve. 84 refs.

2720 **(UCRL—21125) A Large-Grain Data Flow scheduler for scientific parallel processing: Final report.** Babb, R.G. II; DiNucci, D.C. (Lawrence Livermore National Lab., CA (USA); Oregon Graduate Center, Beaverton (USA). Dept. of Computer Science and Engineering). 16 Sep 1988. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01. Order Number DE89001815/JAW.

The work accomplished on the contract can be summarized as follows: used LGDF to model the high level work allocation

portion of an ITSM physics code; modeled the lower level synchronization portions of ITSM physics codes and developed a new parallelization strategy; and developed a new version of LGDF, called LGDF 2, that is better equipped to handle such applications as ITSM physics codes, and implemented an LGDF 2 scheduler for the Sequent. This report covers each of these three areas. 7 refs., 5 figs.

2721 **(UCRL—99386) Physical Volume Repository.** Coleman, S.S. (Lawrence Livermore National Lab., CA (USA)). 1 Aug 1988. Contract W-7405-ENG-48. 6p. (CONF-8810162—2). NTIS, PC A02/MF A01. Order Number DE89001505/JAW.

From 9. IEEE symposium on mass storage; Monterey, CA, USA (31 Oct 1988).

The Physical Volume Repository is that portion of a storage system that stores and mounts physical volumes. This paper describes the architecture of the Physical Volume Repository, its interface, and how it processes client requests. 4 refs., 1 fig.

2722 **(UCRL—99687) Implementation of the GMRES [general minimal residual] method.** Walker, H.F. (Lawrence Livermore National Lab., CA (USA); Utah State Univ., Logan (USA). Dept. of Mathematics). Aug 1988. Contract W-7405-ENG-48;FG02-86ER25018. 15p. (CONF-8810119—4). NTIS, PC A03/MF A01. Order Number DE89001136/JAW.

From Workshop on practical iterative methods for large scale computations; Minneapolis, MN, USA (23 Oct 1988).

We discuss general and specific implementation of the GMRES method for solving large nonsymmetric linear systems. Particular attention is given to issues of numerical reliability and efficiency. Computational results are reviewed.

2723 **Aerospace system simulation at Sandia National Laboratories.** Watts, A.C. pp 777-781 of 1987 Annual Summer Computer Simulation Conference, 19th, Montreal, Canada, July 27-30, 1987, Proceedings. Chou, J.Q.B. San Diego, CA; Society for Computer Simulation (1987). (CONF-870706—).

From 19. annual summer computer simulation conference; Montreal, Canada (27 Jul 1987).

The development of navigation, guidance and control systems for flight test vehicles associated with advanced weapons systems is discussed. Computing facilities used in all-digital simulations, real-time digital simulations and hybrid, hardware-in-the-loop simulations using various elements of guidance hardware and a three-axis motion simulator are examined. The methodology for the validation of flight software and the performance validation for guidance and control hardware is presented.

9903 Information Handling

REFER ALSO TO CITATION(S) 207, 1674, 1996, 2580, 2670, 2694

2724 **(AD-A—195631/7/XAB) Storing and retrieving data in a parallel distributed-memory system. Doctoral thesis.** Potter, T.W. (Brown Univ., Providence, RI (USA). Center for Neural Science). 24 Jun 1988. 11p. (TR—45). NTIS, PC A03/MF A01.

The storage and retrieval of patterns in a Hopfield-like Parallel Distributed Memory is investigated experimentally with a view toward increasing its storage capacity. The first two chapters gives an overview of distributed memories and, in particular, the Hopfield distributed memory. This is followed by a chapter which experimentally identifies the basic storage capacity of the original Hopfield memory when using text patterns. This discussion then experimentally investigates new and untested methods to increase the storage capabilities of a Hopfield-like neural net. Increasing the storage capacity by using the continuous-valved Hopfield memory is explored in chapter 3 and the impact on capacity of data representation is experimentally investigated in chapter 4. We then focus on new ways of storing data (changing the interconnect strengths) including in Chapter 7 developing a new method called Modifying the Energy Contour or MEC. In addition, this Chapter also outlines how to increase error-tolerance through the use of noisy patterns.

2725 **(AD-A—196132/5/XAB) Reliable broadcast protocols. Special report.** Joseph, T.A.; Birman, K.P. (Cornell Univ., Ithaca, NY (USA). Dept. of Computer Science). Jun 1988. 31p. (TR—88-918). NTIS, PC A03/MF A01.

The distinguishing feature of a distributed program is not just that its various parts are distributed over a number of processors but that these parts communicate with one another. The hardware in a distributed system allows a processor to send messages to other processors; the operating system usually extends this facility to allow a process on one machine to send messages to a process on another. The operating system may also provide facilities to set up virtual circuits between processes and may include protocols that ensure a certain degree of reliability in the communication. From the point of view of a programming language, however, these facilities are still rather low-level, and this has led to a search for appropriate high-level abstractions for inter-process communication. Some researchers suggest that distribution be completely hidden from the programmer. They argue for an abstraction that looks like a global shared memory. This abstraction has the advantage that it is simple to program with; writing a distributed program is no different from writing a non-distributed one.

2726 **(AD-A—196291/9/XAB) Detection-theory analysis of visual display performance. Master's thesis.** Mabry, T.R. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1988. 65p. (AFIT/CI/NR—88-126). NTIS, PC A04/MF A01.

This study investigated how information is processed from graphic vs. alphanumeric multi-element visual displays using principles derived from the Theory of Signal Detection (TSD). A diagnostic decision task was used in an evaluation of four different display formats: (1) A numerical display composed of n two-digit numbers arranged in a linear horizontal format; (2) a similar numerical display in which the display elements were arranged in a square-matrix array; (3) an analog-guage display composed of n vertical line gauges also organized in a square matrix array; and (4) a similar analog gauge display in which the display elements were arranged in a linear horizontal format. Performance was evaluated for 1,2,4,9, and 16-element displays and over a range of display durations. Detection performance, as measured by d', increased as the number of display elements was increased up to an asymptotic value that was dependent on display type, arrangement and display duration. Performance was best with analog display elements arranged in a horizontal line. The relative influence of particular spatial element and the total number of elements that influence a subject's response appears to be highly dependent on display type and arrangement.

2727 **(CONF-8810178—1) Standard generalized markup language: A new user's perspective.** Dole, J. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01. Order Number DE89000658/JAW.

From 12. annual practical conference on communication; Oak Ridge, TN, USA (13 Oct 1988).

Standard Generalized Markup Language (SGML) is taking its place as a practical way to solve document exchange problems and to overcome hardware and software incompatibilities. The International Standards Organization adopted SGML as a standard in 1986, and the Department of Defense (DoD) Computer-aided Acquisition and Logistics Support (CALS) initiative requires that defense contractors use SGML to exchange technical information. The power of SGML lies in its capability to identify a document's elements and their interrelationships. Thus, information in a document marked up with SGML tags can be used to create many types of publications from one document database. This presentation will summarize the features of SGML and will demonstrate how word-processing-like software packages permit easy input of SGML tags. 4 figs.

2728 **(DOE/EIA—0415(88)) EIA publication manual: Fourth edition.** Neef, C.A. (USDOE Energy Information Administration, Washington, DC. Office of Planning, Management, and Information Services). 1988. 82p. NTIS, PC A05/MF A01 - GPO. Order Number DE89001907/JAW.

This is the fourth edition of the Publications Manual. It was written to help the staff of the Energy Information Administration (EIA) who are involved in the production process to create and format uniform publications that not only provide information, but readily identify the agency. The manual reflects the substantial changes that have taken place to streamline methods of producing EIA publications over the past few years. Whereas the first edition, in 1979, was written for writers and typists which struggled with producing reports on manual typewriters, this report now reflects the increased use of automation in preparing most EIA publications. EIA has a fully automated photocomposition publishing system. Many of the style features discussed in this manual are automatically produced using EPIC/ICEF2. The need for format sheets and illustrations produced by graphic artists has been significantly reduced. However, the basic style has changed very little. EIA style continues to be based on the Government Printing Office Style Manual with some deviations tailored specifically for EIA.

2729 **(LA-UR—88-3176) The ecology of software configuration management.** Cort, G.P. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-8809148—1). NTIS, PC A03/MF A01. Order Number DE89000317/JAW.

From International softool user's conference; Melbourne, FL, USA (26 Sep 1988).

This paper discusses how to overcome failures and pitfalls in software configuration management. (LSP)

2730 **(ORNL/CSD/TM—261/1) SSCR Automated Manager (SAM) release 1.1 reference manual.** (Oak Ridge National Lab., TN (USA)). Oct 1988. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01. Order Number DE89001946/JAW.

This manual provides instructions for using the SSCR Automated Manager (SAM) to manage System Software Change Records (SSCRs) online. SSCRs are forms required to document all system software changes for the Martin Marietta Energy Systems, Inc., Central computer systems. SAM, a program developed at Energy Systems, is accessed through IDMS/R (Integrated Database Management System) on an IBM system.

2731 **(SAND—88-1811) Administrative Information Systems Plan for FY89.** (Sandia National Labs., Albuquerque, NM (USA)). Nov 1988. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01. Order Number DE89002382/JAW.

The Administrative Information Systems (AIS) Plan was developed to prioritize, track, and control the cost of AIS activities. This annually published plan, in conjunction with quarterly status reports, measures projected AIS activities and progress. The AIS Plan and quarterly reporting are administered jointly by the Director of Computing and an Organization 30 director. Priority development projects are clearly defined and closely managed efforts that consume significant resources. Directorate supplementals describe other AIS activity within each directorate, which may include: production support; technical support; development activity; and other AIS effort.

2732 **Accuracy of processed nuclear data.** Cullen, D.E. (Lawrence Livermore National Lab., L-298, P.O. Box 808, Livermore, CA (US)). *Nuclear Science and Engineering;* **99**: No. 2, 172(Jun 1988).

The results of the International Atomic Energy Agency cross-section processing code verification project are described. This project has been conducted over the last 7 yrs in an attempt to improve the reliability of the results produced by cross-section processing computer codes. Initial comparisons of results received from 42 participants using 13 different cross-section processing codes demonstrated that, even though all of the codes started from exactly the same evaluated data, in no case did the multigroup cross sections calculated by any two codes agree for al materials and groups used in the comparison. This code verification project has led to positive results by improving cross-section processing codes as well as the conventions used to interpret ENDF/B evaluations. In several cases it has led to changes in ENDF/B evaluations. Although this project only addressed nuclear data processing codes, conclusions can be drawn from the results regarding the reliability of other types of computer codes.

9905 Civilian Defense

REFER ALSO TO CITATION(S) 871, 2674, 2676, 2677

2733 **(AD-A—197039/1/XAB) Adaptive machine vision. Annual report.** Stoner, W.W.; Brill, M.H.; Bergeron, D.W. (Science Applications International Corp., Billerica, MA (USA)). 8 Mar 1988. 91p. NTIS, PC A05/MF A01.

The mission of the Strategic Defense Initiative is to develop defenses against threatening ballistic missiles. There are four distinct phases to the SDI defense; boost, post-boost, midcourse and terminal. In each of these phases, one or more machine-vision functions are required, such as pattern recognition, stereo image fusion, clutter rejection and discrimination. The SDI missions of coarse track, stereo track and discrimination are examined here from the point of view of a machine-vision system.

2734 **(LA—11361-MS) Advanced defense technologies in transition.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 30p. NTIS, PC A03/MF A01. Order Number DE89002105/JAW.

This report discusses the sensitivities of current defensive technologies to the treat, how advanced kinetic energy and directed energy weapons (KEWs and DEWs) could reduce them, and their scaling and optimal combinations. The result is a demonstration that an orderly progression from KEWs to DEWs obtains for nominal costs, performance, and threats. 28 refs., 8 figs.

2735 **(LA—11374-MS) Role of advanced technologies in strategic defense.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 35p. NTIS, PC A03/MF A01. Order Number DE89002100/JAW.

This report discusses the role of advanced technologies in strategic defense and reviews the threats, the proposed solutions, the risks involved in implementing the solutions, and the roles advanced technologies could play in reducing the risks. Although current technologies could address nominal threats, advanced technologies would be required for increased threats. 34 refs., 3 tabs.

2736 **(LA—11375-MS) Strategic defense in transition.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 18p. NTIS, PC A03/MF A01. Order Number DE89002099/JAW.

Possible objectives and programs for strategic defense include third-country, accidental, or unauthorized launches; limited attacks; initial military threats; and defense value. Their essential features, technologies, and developmental programs are reviewed with the goal of identifying a path that would benefit from their commonalities. 10 refs.

2737 **(LA—11376-MS) Adaptive preferential defense and discrimination.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 45p. NTIS, PC A03/MF A01. Order Number DE89002098/JAW.

This report discusses adaptive defenses, their properties and sensitivities, and how their effectiveness varies with the size and structure of the threat. For projected midcourse interceptors and sensors, adaptive defenses are optimal; they dominate preferential attacks. Their suppressed sensitivity to decoys is used to derive optimal allocations of resources between boost and midcourse. 9 refs., 20 figs.

2738 **(LA—11406-MS) Impact of carrier vehicle mass and cost on boost interceptors.** Canavan, G.H. (Los Alamos National Lab., NM (USA)). Oct 1988. Contract W-7405-ENG-36. 16p. NTIS, PC A03/MF A01. Order Number DE89002092/JAW.

This report examines the scaling of space-based interceptors (SBIs) when the mass and cost of the carrier vehicles (CVs) are significant. The report builds on an earlier analysis of the optimization of SBI constellations that were dominated by the mass and cost of CVs or buses. It concludes that these earlier findings are not changed qualitatively by these corrections. 11 refs., 4 figs.

2739 **(PB—88-236245/XAB) SDI (Strategic Defense Initiative): technology, survivability, and software.** (Office of Technology Assessment (U.S. Congress), Washington, DC). May 1988. 289p. (OTA-ISC—353). NTIS, PC A13/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card no. 87-619857.

This report reviews the status of the various SDI technologies and system components. It analyzes the feasibility of producing dependable software of the complexity that advanced BMD systems would require. Finally, it summarizes what is now known, and unknown, about the probable survivability of such systems against concerted enemy attacks of various kinds.

2740 **(RAND-P—7404) Agenda for the strategic defense initiative.** Kent, G.A. (RAND Corp., Santa Monica, CA (USA)). Jan 1988. 9p. NTIS, PC A02/MF A01.

The goal of moving from an offense-dominated to a defense-dominated international strategic scene is desirable and feasible, and can best be achieved in cooperation with the U.S.S.R. Such a shared goal implies that deploying strategic defenses is clearly subordinate to the more encompassing matter of reducing ballistic missiles to zero or near zero. In addition to seeking Soviet cooperation, the U.S. should continue to discuss the pros and cons of such a direction with its allies, continue to conduct the strategic defense initiative (SDI) technology program aimed at an earth-based defense with passive defense, and continue to adhere to the 1972 ABM treaty.